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From Sagebrush to Roses on the Columbia

By Leo A. Borah

FULFILLMENT of a 35-year dream—the official turning on of water to start a million-acre State and Federal irrigation project in the Columbia River Basin—began near Moses Lake, Washington, on May 29, 1952. It is like adding a new State to the Union.

Out of sagebrush desert which, save for some ill-fated attempts at dry farming, had lain desolate and useless for centuries, I saw spring in 24 hours a fertile farm, plowed, graded, leveled, seeded, and fully equipped with buildings, livestock, irrigation ditches, and sprinklers.

This almost magical "farm-in-a-day" was complete even to furniture, groceries, clothing, and children's toys. Farm and equipment were donated by private business organizations, and the Veterans of Foreign Wars chose Donald D. Dunn from thousands of nominees as the veteran most deserving of the gift.

A minute after midnight fireworks had signaled the beginning of the day's labor, and more than 300 volunteer workers had fallen to with a will. They built an ultramodern three-bedroom house, large machine and cattle sheds, and other farm structures on concrete foundations poured in advance (pages 604, 605). With 70 pieces of heavy machinery raising blinding clouds of dust, they cleared off sagebrush, plowed and leveled 80 acres of irrigable land, and planted alfalfa, pasture, oats, red clover, corn, and beans.

First Irrigation from Grand Coulee

The modest 30-year-old veteran received the deed to the property, debt-free, from an official of the State Columbia Basin Commission.

Then came the dramatic moment for which people of eastern Washington had been waiting since World War I. The Commissioner of the federal Bureau of Reclamation turned on the water—the first drawn for irrigation from the lake backed up by Grand Coulee Dam.

As sprinklers began to shower part of the tract and rills to run through the rest of it, what had been sun-baked, dust-ridden waste became in a moment well-watered cropland.

The water came from a vast, sealed equalizing reservoir into which it had been raised by gigantic pumps. Gravity canals and siphons will carry it to 1,029,000 thirsty acres of potentially rich agricultural land.

The reservoir millenniums ago was the temporary bed of the Columbia River. Blocked by an ice sheet, the stream changed its course. Then the ice receded, and the river reverted to its former bed, leaving high and dry its temporary canyon and the sheer cliff of a mighty cataract. Dry Falls, near Coulee City, is now a Washington State Park.

Farseeing Men Dreamed of This Day

Lands to be watered from Grand Coulee are of course only a small portion of the vast Columbia Basin. The Basin includes in its 259,000 square miles (219,300 in the United States) western Montana, nearly all of Washington, northern and eastern Oregon, much of Idaho, and smaller portions of Utah, Wyoming, and Nevada. The remaining 39,700 square miles are in Canada (map, pages 576-7).

Though the Basin has only a fiftieth of the national population, it contains approximately seven percent of the area of continental United States and 40 percent of the country's potential hydroelectric power.

As I stood on a windy hill with Charles E. Johns, a Washington State official, and looked down on the Dunn farm, we recalled James O'Sullivan, pioneer irrigation enthusiast, and Rufus Woods, farseeing publisher of the *Wenatchee Daily World*, who are deservedly called fathers of Columbia Basin irrigation.

When I went to Spokane as a high school teacher just after the end of World War I,

Kaminskin, U. S. Bureau of Reclamation

Columbia Basin Carrots Grow Like Jack's Beanstalk

Proving the amazing fertility of reclaimed sagebrush soil, this specimen took on gigantic proportions when harvesters neglected to pick it. It was produced in the Hunt irrigation project near Jerome, Idaho. Young Michael Weatherwax finds the vegetable an armload.

these men were being laughed at as dreamers and crackpots because they advocated pump irrigation to reclaim the land we now saw emerging from desert. Despite discouragement and ridicule, however, the two enthusiasts continued their campaign. Neither lived to see the dream accomplished, though the big pumps were under construction at the time of Mr. Woods's death in 1950. One of the major subsidiary dams has been named for Mr. O'Sullivan. In 35 years what critics branded as preposterous has become reality.

A Vast Empire to Be Developed

Today Spokane, the "Capital of the Inland Empire," proudly advertises itself as the "Gateway to the Columbia Basin" (page 610). Power from the Spokane River, which flows through the center of the city, and trade with farming and mining communities have insured steady growth. Now the opening of the Grand Coulee project gives added impetus. Since 1940 the population has increased from 122,000 to more than 160,000.

The country around Grand Coulee Dam will not bloom gardenlike overnight. This year only about half of 950 80-acre farms received water. Others will be added at the rate of some 60,000 acres a year until the entire project is under cultivation. Meantime authorized irrigation plans will be developed elsewhere in the Columbia Basin. Possibilities of this enormous future empire stagger the imagination.

The day before the Moses Lake ceremony I had flown out from Washington, D. C., to the Seattle-Tacoma Airport, where Charlie Johns and his assistant A. F. (Tony) Raiter, Jr., met me. We stayed overnight in the phenomenally growing city of Seattle and early next morning drove over Snoqualmie Pass to the Columbia River Basin.

No matter how often I make that trip, I always marvel at the sudden change of climate and vegetation as the highway crosses the summit of the Cascade Range. One moment we were in the lush fir, spruce, and cedar rain forest of the Pacific slope; the next in dry reaches of western pine. Here rainfall drops from an annual average of more than 100 inches on the west side to less than 10 east of the divide.

Just over the summit we passed Keechelus Lake in a cuplike basin with steep, timbered sides rising 1,000 feet. A dam at the south end of this lake helps regulate the flow of the Yakima River for irrigation.

At Ellensburg, seat of the Central Washington College of Education, we were in the lovely valley of the laughing Yakima River. The town, started in 1867 as a trading post by William Wilson, renegade white leader of a band of Indian raiders, was once called "Robber's Roost." Today the only reminders of wild West days in this city of nearly 10,000 are an annual rodeo in late summer, some Indians dressed in tribal finery on gala occasions, and a few descendants of Chinese miners who followed an early gold rush.

Irrigation from the Yakima River is the source of present prosperity. In the shadow of sere brown mountains, all kinds of fruits and vegetables thrive. The incredibly rich soil was cast up eons ago as volcanic ash when Mount Rainier, which lifts its detruncated snow crown on the horizon, erupted and blew off about 2,000 feet of its top.

Yakima, less than an hour's drive to the south by a highway winding along the river canyon through breath-taking scenery, is truly a wonder city, the center of a green oasis conjured by irrigation from the sagebrush. Here are produced enormous quantities of peaches, apricots, plums, apples, pears, cherries, grapes, and nuts as well as vegetables, sugar beets, wheat, hops, and other crops.

Hundreds of railroad refrigerator cars move out of Yakima in the fruit season, and the smooth paved highways are crowded with trucks carrying produce to Seattle. In the autumn big apple-boxing and shipping plants employ armies of workers, and canneries hum with activity most of the year (page 592).

Community spirit is remarkable. In the early 30's construction was started on a big hotel. Depression halted the

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Pomeroy, U. S. Bureau of Reclamation

Tall Corn Waves → Where Sagebrush Grew

This hybrid corn grows on the Bureau of Reclamation's experimental farm near Moses Lake. Its growing season is 120 days, and the yield is 100 bushels or more to the acre. Though virgin soil is 18 to 30 inches deep, it is lacking in nitrates and humus, and fertilizers must be added for most crops.

work, and for years a concrete skeleton stood gaunt against the skyline. Outside capital was sought to finish the building a few years ago, but Yakima leaders decided the price was too high. By local subscription they raised money to erect in 1949 a new 14-story aluminum hotel.

Petrified Trees 10,000,000 Years Old

We made a short detour from the highway between Ellensburg and Moses Lake to visit Ginkgo Petrified Forest State Park, a tract of 5,980 acres containing opalized trunks of trees, most of them of prehistoric species.

"Geologists say this forest was buried in molten lava about 10,000,000 years ago," Charlie told me. "Wind and rain through the centuries have uncovered it."

Moses Lake farmers have proved that land in this arid region needs only water to produce fine crops. For several years they have been irrigating their fields by ditch and sprinkler systems fed from the lake and from wells.

The country immediately surrounding the booming little city is refreshingly green. Farther away dust devils dance over flat, monotonous sagebrush plains. Not a tree is in sight for miles save in the town and its environs.

At Moses Lake the U. S. Air Force maintains Larson Base where the latest and fastest jet bomber planes, the B-47 and B-52, built by the Boeing Airplane Company of Seattle, underwent preliminary flight tests. A large part of the aluminum in their construction comes from the reduction plants in the Columbia Basin.

Another big national defense establishment in the Basin is the Hanford Operations, Washington, about 40 miles south of Moses Lake. There the Atomic Energy Commission is producing vital war materials.

After the farm presentation near Moses Lake, we headed west for Wenatchee. Ray Atkeson, taking pictures to illustrate this article, was fighting clouds of dust down on the farm-in-a-day.

Between Moses Lake and Quincy the dust storm became so thick that Tony, driving the car, had to turn on his lights. Most of the land along our way was freshly plowed, and the high, chill wind was whipping it unmercifully. When we reached Quincy, however, the air was clear. This town is another thriving community that irrigation has created and made prosperous.

Beyond Ephrata, Columbia Basin administration headquarters, we momentarily mistook for snow huge heaps of fertilizer shipped in from Idaho to enrich reclaimed land. Concrete-lined irrigation canals and big siphon pipes for lifting water over ridges were ready to receive the flow from Grand Coulee.

Next morning, Memorial Day, we went back to Ephrata. The town, gaily decorated with flags and bunting, was putting on a "Little World's Fair" in celebration of the turning on of irrigation water (page 609).

George D. Zahn, one of the members of Washington State's Columbia Basin Commission, gave us maps and made arrangements for us to be guided through Grand Coulee Dam.

As we started for the dam, Charlie reminisced about the early days of the Columbia Basin irrigation campaign.

"Here in Ephrata," he said, "Rufus Woods gathered the material for the famous 'Munchausen' story he published in his *Wenatchee Daily World* in 1918 to tell about the fabulous possibilities of irrigation in the Basin desert. That story was what started the Columbia Basin Irrigation League and led to the building of Grand Coulee Dam."

Our road took us through the popular resort town of Soap Lake on the shore of a body of mineral water. There a water carnival was in progress to celebrate the starting of Grand Coulee irrigation.

Dry Cliff of Prehistoric Waterfall

The great dam backs the Columbia River into long, narrow Franklin Delano Roosevelt Lake, which extends to the Canadian border, 151 miles upstream. If a treaty agreement were to be reached with Canada, the river would be backed up farther and the Arrow Lakes of British Columbia could be utilized for water storage.

We skirted the shores of the chain of three lakes in Sun Lakes State Park and climbed by twisting switchbacks to the brink of Dry Falls, the 417-foot cliff nearly three miles wide over which the Columbia poured in prehistoric times.

By-passing Coulee City, our highway took us for nearly two miles along the top of the South Coulee Dam (newly rechristened Dry Falls Dam) of the equalizing reservoir. This long rock- and earth-fill structure seals the lower end of the reservoir and will keep irrigation water from inundating the town and wasting itself over Dry Falls. A similar dam seals the north end of the reservoir.

At times when power produced exceeds the demand, the excess is used to pump water into the equalizing reservoir; there it is stored until needed for irrigation.

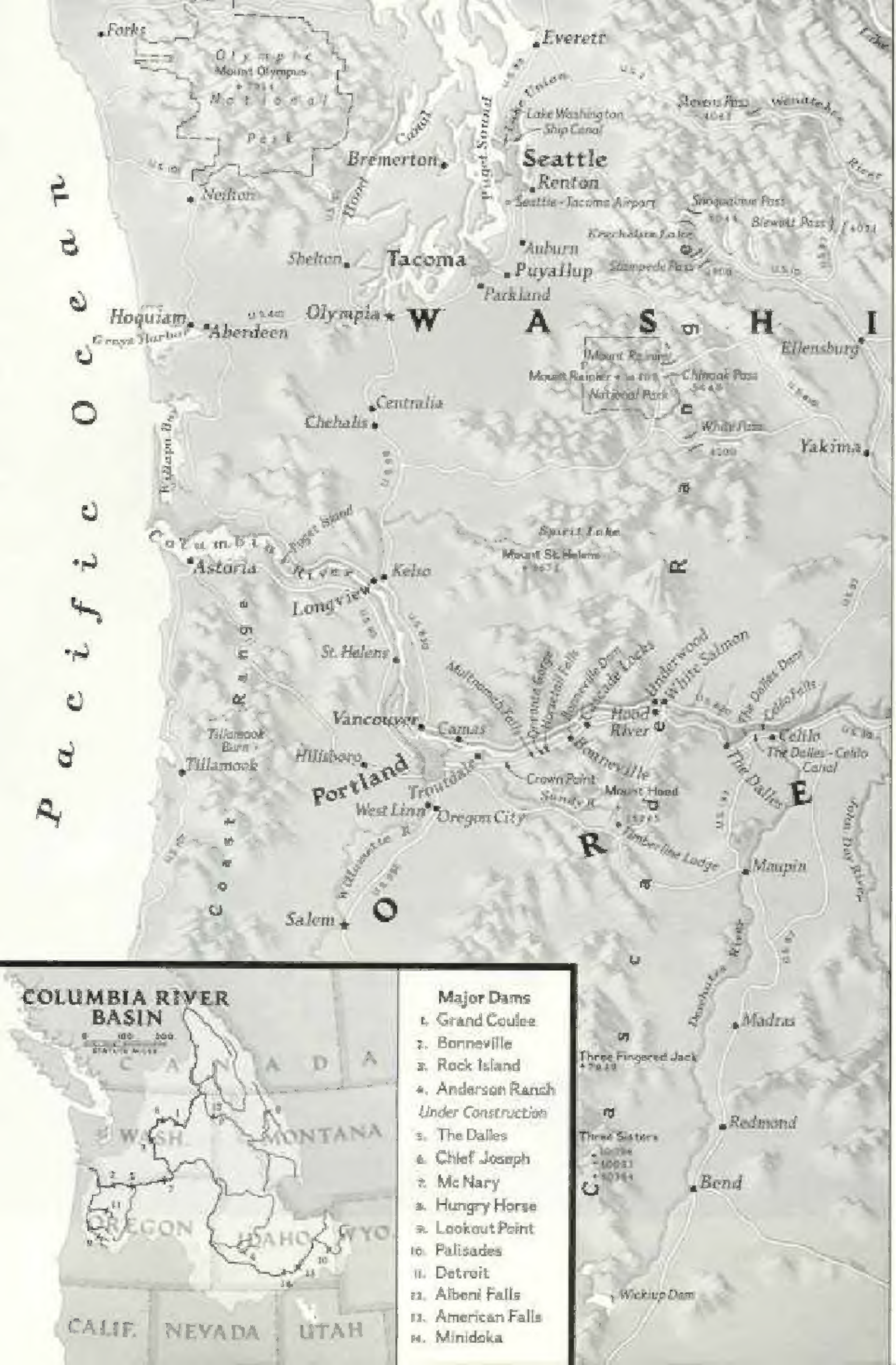
Though the reservoir was not full, there was a considerable depth of water in part of it. Steamboat Rock, a landmark I had ridden past often in the 30's on the old State highway, stood now as a cliff-sided island in a rippling blue lake.

At the north end of the reservoir our way dipped steeply through the town of Grand

Ray Atkeson

Cascading, the Willamette River Turns as White as the Paper Produced by Its Power

Crown Zellerbach Corporation (pages 594, 596) manufactures newsprint at its West Linn, Oregon, plant (left). Oregon City stands across the stream.


Pacific Ocean
Forks
Olympic National Park
Mount Olympus
Everett
Lake Washington Ship Canal
Bremerton
Puget Sound
Hood Canal
Seattle
Renton
Seattle-Tacoma Airport
Snoqualmie Pass
Stevens Pass
Wenatchee
Blewett Pass
Kachelus Lake
Stampede Pass
Nelson
Shelton
Tacoma
Auburn
Puyallup
Parkland
Hoquiam
Aberdeen
Olympia
WASHINGTON
Ellensburg
Mount Rainier
Mount Rainier National Park
Chinook Pass
Centralia
Chehalis
Yakima
Spirit Lake
Mount St. Helens
Astoria
Kelso
Longview
St. Helens
Multnomah Falls
Bonneville Dam
Cascade Locks
Underwood
White Salmon
The Dalles Dam
Celilo Falls
Vancouver
Camas
Hood River
Celilo
The Dalles-Celilo Canal
Tillamook Burn
Tillamook
Hillsboro
Portland
Troutdale
Crown Point
Sandy R.
Mount Hood
The Dalles
West Linn
Oregon City
Timberline Lodge
Maupin
Salem
Madras
Three Fingered Jack
Redmond
Three Sisters
Bend
Wickiup Dam
COLUMBIA RIVER BASIN
CANADA
WASH.
MONTANA
OREGON
IDAHO
WYO.
CALIF.
NEVADA
UTAH
Major Dams
1. Grand Coulee
2. Bonneville
3. Rock Island
4. Anderson Ranch
Under Construction
5. The Dalles
6. Chief Joseph
7. Mc Nary
8. Hungry Horse
9. Lookout Point
10. Palisades
11. Detroit
12. Alboni Falls
13. American Falls
14. Minidoka

A National Geographic Map

Columbia, North America's Fourth River in Volume, Leads in Power Production

Fourteen major dams are in operation or under construction (inset). Shaded area shows the million-acre tract, larger than Rhode Island, to be irrigated by Grand Coulee. Of all the rivers on this continent, only the Mississippi, the Mackenzie, and the St. Lawrence surpass the Columbia in flow.

Coulee to the foot of mighty Grand Coulee Dam. An official guide escorted us up to the highway which runs across the top of the towering structure.

Stepping to the rail on the spillway side, I looked with a shudder down the steep wall to the white spray raging a dizzy distance below me. Water gushing 14 feet deep from 11 drum gates was a pale emerald so clear that I could see through it tiny discolorations on the concrete face of the dam. I crossed the road and looked over the opposite rail into the still depths of Roosevelt Lake.

Biggest Concrete Structure on Earth

"How deep is it?" I asked.

"About 480 feet," the guide replied. "The river is high now. Sometimes in winter it gets so low that no water goes over the spillways. Then all of it passes through the turbines. The overflow you just watched spouting from the drum gates is going to waste. This summer the plant is peaking at two million and a quarter kilowatts."

Although not so high as Hoover Dam (726 feet) on the Colorado River or so long as Garrison Dam (2¼ miles) on the Missouri in North Dakota, Grand Coulee Dam is the largest concrete structure in the world. It is 4,173 feet long and 550 feet high from the granite bedrock on which it rests to the 30-foot-wide highway that crosses its top. Containing 10,230,776 cubic yards of concrete and weighing about 22 million tons, it is a mass that even the Columbia in spate cannot tip over or slide on its base (page 603).

Within the dam are miles of inspection galleries and shafts. The spillway—half as wide and twice as high as Niagara Falls—is flanked by two powerhouses. At the west

end behind the main structure is a wing dam, the base for the pumping plant.

We went into one of the roadside towers and took an elevator to the bottom to watch one of the 18 giant turbines turning a generator. For each generator there is a group of three transformers outside the powerhouse. These transformers take energy from the generator at low voltage and deliver it to outgoing lines multiplied nearly 17 times. Eventually the power goes by long-distance transmission lines to the Bonneville Power Administration, which sells the entire output from both Bonneville and Grand Coulee.

An elevator in a tower near the opposite end of the dam took us to the depths of the pumping plant where two of the huge pumps were in action. Although discharge pipes for all 12 pumps are in place on the hillside above the dam, only six are now being installed. The original intention was to irrigate a million acres in the Big Bend wheat country, but inasmuch as some of this area is already producing bumper crops under dry farming, that part of the plan has been deferred for the present. The two pumps I saw in action and four others being built are sufficient for the initial stage.

One Pump Would Supply Chicago

Each operated by a 65,000-horsepower motor, these pumps take water from 80 feet below the surface of Roosevelt Lake and deliver it into a feeder canal 280 feet above. At full power each pump lifts a billion gallons of water every 24 hours—an amount which would be more than enough to supply the needs of the city of Chicago.

We drove up the hill above the dam to the headworks of the feeder canal. Bursting from the mouths of two discharge pipes 12 feet in diameter, constant streams of water went roaring down the canal, slightly less than two miles long, to plunge into the equalizing reservoir.

"We could fill it fast," our guide said, "but it has been dry for thousands of years, since the Columbia River deserted it, and we want to give the floor time to become thoroughly soaked and waterproof."

Besides the Grand Coulee Dam pumping plant, the Columbia Basin irrigation project includes two smaller ones lifting water 167 feet directly from the river to irrigate 5,500 acres near Pasco, Washington. These pumps will be salvaged when the gravity system is completed.

As a proving ground for the main system, the Pasco project has been valuable. Forty-five young farmers started working irrigated land there in 1948. In 1950 their average gross income was $123 to the acre.

Pasco, which grew from less than 4,000 population in 1940 to more than 10,000 in 1950, was celebrating the Grand Coulee opening. It is 130 miles from the big dam and would have waited 10 years for water had not the Bureau of Reclamation installed the small pumps and located experiment farms there three years ago.

For carrying life-giving water to the main irrigation project (it is approximately 80 miles from north to south and 60 miles from east to west) a stupendous network of canals, earth-fill dams, tunnels, and siphons is required. The four subsidiary dams measure more than six miles in length. The eight principal canals total nearly 500 miles. There are seven miles of tunnels and 28 miles of siphons.

At my comment on the clarity of the water I had seen at the spillway and in the feeder canal, the guide told me: "The mountain rivers that feed the Columbia flow through lakes where the sediment settles out of them. For this reason, sedimentation of Lake Roosevelt is no problem. And because the water is so pure, it causes very little wear on the pumps."

At present no land is open for homesteading in the project. About 90 percent of the area is privately owned. Farms up to 80 acres of first-grade land can be bought at low prices (the Government prohibits speculation), but the prospective purchaser must add to his investment the cost of irrigation and annual water rent.

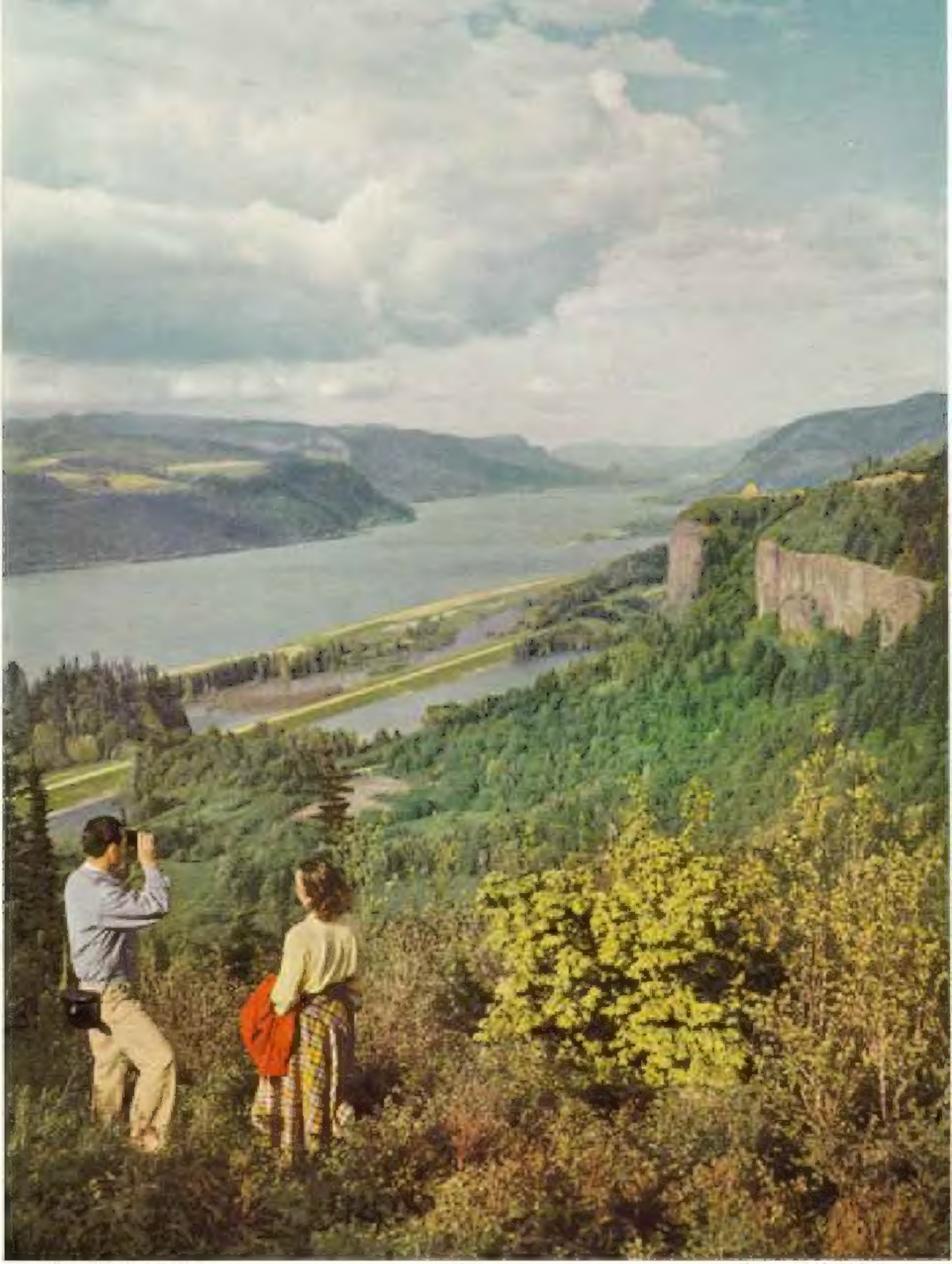
For experienced farmers, irrigable land in the Columbia Basin represents excellent opportunity, but it is not cheap, and buying it means almost certain ruin for tyros in agriculture.

Dams already in operation and under construction in the Columbia Basin will produce more than 8,000,000 kilowatts of power (map, pages 576-7). Additional ones authorized by the Federal Government and scheduled by private companies will bring the amount to nearly 13,000,000. As markets for power increase, the authorized dams will be constructed and new irrigation projects will be opened. There is an estimated minimum of 30 million kilowatts of potential power in the Columbia River and its tributaries.

To an Apple Capital of the World

If the authorized dams on the Snake River in eastern Washington (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) are completed, light-draft vessels will be able to carry goods all the way from Portland, Oregon, to Lewiston, Idaho.

Charlie, Tony, and I drove back to Wenatchee from Grand Coulee by a route I



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Ektachrome by Ray Atkeson

Majestically the Columbia Sweeps Along, 725 Feet below Towering Crown Point

Famous Columbia River Highway swings out to Vista House atop the basalt promontory (right); thence to a mid-air ledge on the cliffside. In 17 miles it passes nine spectacular cataracts gushing hundreds of feet above it. Horsetail Falls drops so close that spray drifts across pavement. This couple, having left the old road, looks down on the new Columbia highway.

Mount St. Helens and Spirit Lake Set in Virgin Wilderness

[illegible]

Indians Net Coho Salmon

[illegible]

Portland's Myriad Lights Bloom Out to Dispel the Gathering Darkness

The city's business center lies on the floor of Willamette Valley, which is surrounded by ever-towering hills. Many homes are built with picture windows framing the mountains.

Mount Hood's Snowy Crown Glows in the Westering Sun's Last Rays

[illegible]

Hillsboro's Dairy in Portland's Annual Rose Festival Revives Memories of Pioneering Days

and not traveled before. From the dam we went south to Alstown and thence across the Big Bend wheat country to Waterville.

The country near Coulee City was of course still desert, but up on the plateaus green fields of wheat rippled to the horizon. In Waterville it was pleasant to drive along shady streets. We had seen few trees on our trips elsewhere.

Beyond Waterville the highway enters Pine Canyon and descends by switchbacks 2,000 feet in a few miles through magnificent forests of yellow pine. Views from some of the hairpin turns were glorious.

Orchards Crowd the Countryside

Apple-blossom time was over in the Wenatchee country, and tiny fruit was appearing on the trees that crowd to the roadside along the Columbia River. Everywhere sprinklers were going. The land by the river was fresh and green, though hills in the distance loomed forbiddingly brown.

In Wenatchee apple growing is more than a business—it is a fine art. Orchards occupy every available space for miles along the Columbia and Wenatchee Rivers. When the city holds its annual Apple Blossom Festival in early May, the whole countryside is a fragrant fairyland.

Apple trees were first planted at Wenatchee in 1872, but it was not until after the turn of the century that pump irrigation made them thrive. Now the city ships out every fall some 20,000 carloads of Delicious, Winesap, Stayman, and Jonathan apples. As we drove through the orchards, we saw cherries ripening here and there, and some other fruits but apple trees far outnumbered all the rest.

Every scientific method of improving quality and yield of fruit is practiced at Wenatchee. In fall the trees are carefully pruned, and the cuttings are chipped and worked into the soil as mulch. Spraying is done with power machines, airplanes, and helicopters. After years of experiments a new Golden Delicious apple with a spicier flavor than other types has been developed.

On a high, rocky bluff overlooking the confluence of the Wenatchee and Columbia Rivers is the "Garden in the Sky," a remarkable 5-acre rock garden developed as a hobby by Herman Ohme and his family. Mr. Ohme hauled soil to the top of this 1,250-foot promontory and planted in it flowering mosses and other low-growing plants. Interspersed among the flower beds are 14 varieties of evergreen trees, specimens of kinds that grow in the Pacific Northwest.

To keep the garden growing, the owner pumps irrigation water up the height. A rock-built lookout affords a panoramic view of the sparkling rivers, the clean little city, and the great orchard valley.

"One day in Apple Blossom Week we had 18,000 visitors up here," Mr. Ohme told me.

The garden is a blaze of color from early spring to late fall. Seen from the highway below the hill, it looks like an artist's palette splashed with all the hues of the rainbow.

Wenatchee has only about 13,000 population within the city limits, but it serves a thickly settled suburban area. The late Rufus Woods's *Wenatchee Daily World* had a daily door-to-door delivery circulation of 17,000 when the town had fewer than 12,000 people.

Like Yakima, Wenatchee proves the fertility of the dry Columbia Basin under irrigation. It is hard to believe that this orchard city was sagebrush desert little more than 50 years ago.

We drove to Seattle over beautiful Stevens Pass, one of five highway passes crossing the Cascades in Washington between the Columbia Basin and the Pacific slope.

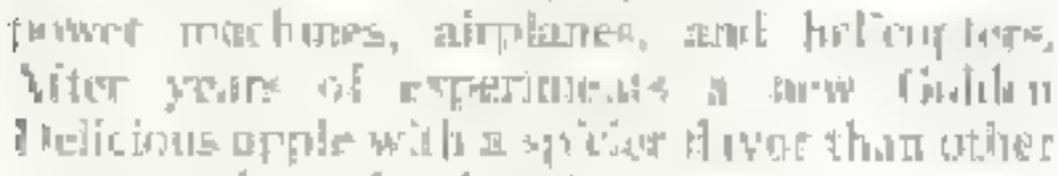
Portland, metropolis of the Columbia Basin, was my headquarters while I was making surveys of the lower reaches of the Columbia River. In November, 1951, I was fortunate in having for a traveling companion V. A. (Mac) McNeil, who had gone all over Oregon with me in 1949 when I was gathering material for an article on the State.*

Columbia Gorge Revisited

One bright morning we drove out of Portland on the famous Columbia River Highway skirted the Sandy River, where Portland goes fishing during the spring smelt run, and were soon in familiar Columbia Gorge (pages 579 and 602). The highway winds along for miles halfway up the forested sides of basalt cliffs overlooking the Columbia River.

Vista House atop Crown Point lured us to pause briefly for a view of the majestic Columbia from the 725-foot promontory. Then on we went past waterfalls gushing from the heights above us. Multnomah Falls, dropping 620 feet into a tree-ringed basin near the road, Oneonta Gorge, cooled by constant breezes sifted by the lofty cataract that feeds its foaming creek, Horsetail Falls, casting spray across our road. We

* See "Oregon Finds New Riches," by Leo A. Borah, National Geographic Magazine, December, 1949.



Photograph by Eliot Porter

Idyllic Oneonta Gorge Invites the Traveler to Cool Off

This enchanting spot near the Columbia River Highway is a favorite with picnickers. Trees which used to abound, have disappeared, but the banks of cliff walls clothed with lichens, ferns, and [illegible] remains unchanged. A lace [illegible] the fresh of the force stirs air conditioning breezes

Kennewick, Washington, Farmers Pump Mint Hay into a Distilling Vat

[illegible]

[illegible] United States received waterfalls in 17 states of the [illegible] Indians.

We [illegible] Dam, for at first time [illegible] because of security reasons [illegible]

How is the salmon [illegible] the Columbia [illegible]

The farmer [illegible] said, [illegible] fact [illegible] good [illegible] to [illegible]

Many tribes fell victim to the power of Indians [illegible] Dam [illegible] 27 out of every 100 [illegible] Dam.

[illegible] passed [illegible] the name [illegible] Second [illegible] Columbia, [illegible] State [illegible] superintendent. We raised our [illegible] of [illegible] Grand Coulee. Yet Dam [illegible] has created 181 miles [illegible] Oregon [illegible] further [illegible]

[illegible] "Mr. [illegible] Indian [illegible] power [illegible] Indians [illegible] and [illegible]

Walla Walla, Place of Many Waters

[illegible] Dam [illegible] Indian [illegible] Dam [illegible] Indians [illegible] the [illegible] of the river [illegible]

Molten Aluminum Pours into Molds for Casting into 1,000-pound Pigs

[illegible] Columbia [illegible] Washington, plant [illegible] Kaiser Aluminum & Chemical Corporation [illegible]

[illegible] fish ladders will be constructed.

The sweeping wheatlands of Walla Walla, Washington, [illegible] the world. McNary [illegible] irrigation and power [illegible] farm development.

Walla Walla, 27 miles inland [illegible] Dam [illegible] Snake River dams [illegible] river north of Walla Walla [illegible] products and grain to world markets.

Near Walla Walla in 1847 occurred the famous Whitman massacre, when Indians killed the missionary Marcus Whitman and his colleagues. Whitman College, founded by the Reverend Cushing Eells, Congregational missionary, in memory of his friend, is one of the distinguished small colleges of the West. [illegible]

In Walla Walla, [illegible] 24,000 persons, [illegible] some of the most [illegible] vegetable canneries [illegible] plant in the West. Asparagus and peas [illegible]

[illegible] Walla Walla [illegible]

The [illegible] transportation that Walla Walla [illegible] boat [illegible] the Columbia. In the [illegible] of the 1860s [illegible] Oregon settlers

were coming into the Willamette Valley, most of them avoided the dangerous overland routes past Mount Hood by lowering their goods on river steamers and portaging around Umatilla, Celilo, and Cascade rapids.

Nowadays numerous tugboats drawing log barges ply the Columbia between Portland and Lewiston. They pass Celilo rapids by The Dalles-Celilo Canal and Locks. When the McNary Dam is finished, river traffic will go around it by similar locks.

Materials for building the new dam were being brought to Umatilla in barges at the time of our visit. On the return trip to Portland the hulls which had carried cement to the dam were loaded with wheat. Tall elevators at the riverside filled the holds. Long spouts swung out over the water. Oil barges were taken downstream empty.

River transportation, flood control, and reclamation of desert lands, though economically important, cannot alone justify construction of the tremendous system of dams in the Columbia Basin. Production of hydroelectric power to satisfy the phenomenally growing demand of new industries in the Pacific Northwest is a major reason.

Six Aluminum Plants Now Operating

When I was in [illegible] 1945, I had learned about large deposits of bauxite low-grade aluminum-ore rock, near Portland.

Although the aluminum companies have acquired land and tested the bauxite beds, they have done no actual mining there. The alumina, a white, granular powder, now being used in six reduction plants in Oregon and Washington is shipped from bauxite-refining plants in Arkansas, Alabama, Louisiana, and elsewhere. Eventually the bauxite may be used, but for the present imported and domestic bauxite is cheaper.

In 1939 the Aluminum Company of America built a huge plant at Vancouver, Washington, just across the Columbia from Portland. In 1941 the Reynolds Metals Company began reduction at Longview, Washington, 48 miles downstream. To meet war needs, the United States built a third plant at Troutdale, Oregon, which it subsequently sold to Reynolds.

From the Government the Kaiser Aluminum & Chemical Corporation purchased two other wartime reduction plants, one at Mead near Spokane, and one at Tacoma. The Aluminum Company of America completed a sixth plant at Rock Island Dam, near Wenatchee.

At present these Pacific Northwest reduction plants have about 40 percent of the Nation's capacity to produce new aluminum, essential vital to the national defense. The great Boeing airplane factory at Seattle is their largest Northwest customer. For

the greater part of the output, however, goes to eastern markets.

Mac and I went through the Alcoa mills at Vancouver to watch alumina pass through intricate processes and emerge as pig aluminum. It is taken in solution in a molten cryolite bath, and an electric current is passed through it to reduce it to metal—aluminum.

Aluminum melts at about 1,300° Fahrenheit, a temperature considerable lower than that required to melt steel. Cooling, it is cast into pigs and then into ingots.

From the reduction plants we walked into a rod and bar mill where the ingots were converted by machines into aluminum cables with cores of fine steel wire. I had seen many such cables on the long-distance transmission lines carrying power from Grand Coulee. They are [illegible] conductors of electricity. The steel core [illegible] the cables and prevents [illegible].

Pushed by a Stern-wheeler, an Ocean [illegible] Goes into Dry Dock at Portland

[illegible] the Willamette River [illegible] Portland [illegible]

In [illegible] of the large [illegible].

It takes [illegible] two pounds of [illegible] one pound [illegible]. In making a pound of alumi-num [illegible] 10 kilowatt-hours of electricity.

[illegible] power [illegible]. We got [illegible] from the [illegible] Power Administration.

Vancouver, oldest settlement in Washing-ton, was founded in 1824 as a Hudson's Bay Com-pany fur-trading post under the command of Dr. John McLoughlin, its factor. The following year old Fort Vancouver was built. The location [illegible] a part of a United States defense system in 1848, [illegible] it was not [illegible] until 1947. The [illegible] barracks and grounds are now a [illegible] park.

Vancouver was incorporated as a town in 1857. Today it is one of the fastest-growing cities in the United States. It had a popu-lation of only 18,788 in 1940. In 1950 the census recorded [illegible] within the city limits.

Longview, a City Made to Order

At the end of World War II, [illegible] Kaiser's Vancouver [illegible] closed down, but [illegible] the Alcoa mills, completed in 1940 at the [illegible] Company plant [illegible]

[illegible] [illegible]

Miss Yakima Packs Gift Apples

[illegible]

[illegible] products [illegible] saves its sawdust [illegible] for [illegible] plywood plants and factories producing [illegible] and sawdust.

My son and I went [illegible]. In the first, we wandered [illegible] the Long-Bell Company. We were surprised to see a score of [illegible] in the very [illegible] [illegible]. A company official [illegible]. This [illegible] given to a watch [illegible] several years ago.

Long-Bell was [illegible]. Even the [illegible] sawdust was being [illegible] and [illegible] into [illegible].

On the Weyerhaeuser property nearby I saw bark being ground [illegible] to be [illegible] and sold as [illegible] plastics, adhesives, [illegible] and starts. [illegible] Another department was making fireplace "logs" from sawdust.

[illegible] we watched [illegible] large [illegible] the [illegible] of logs with water jets [illegible] by 1,000 to 1,500 pounds pressure to the square inch (page 97).

If a man should fall into these jets, [illegible] the company's [illegible] safety [illegible] precautions.

Down on the water front, [illegible] cranes of the port of Longview were unloading [illegible] Columbia River [illegible] logs. [illegible] were [illegible] some of the

Longview, the planned city built by the late R. A. Long of Long-Bell Lumber Company [illegible] 20,000 [illegible].

In Longview two giant manufacturing concerns are the Long-Bell Lumber Company and the Weyerhaeuser Timber Company.

Long-Bell makes [illegible] lumber [illegible] and [illegible] wood.

Weyerhaeuser [illegible]

[illegible] his way than with an [illegible] tail. The [illegible] like dress of high-priced [illegible]

Astoria and the Fishing Industry

To obtain firsthand information about the fisheries which for gen[illegible] Astoria, the town found[illegible] by the John Jacob [illegible] Columbia River. It was the first [illegible] settlement [illegible] Oregon. [illegible] year-long [illegible] and [illegible] water and [illegible] [illegible] [illegible] summer and fall [illegible] [illegible] [illegible] way up [illegible] places where [illegible] [illegible] years six, [illegible] [illegible] They do not eat after they [illegible] salt water, but will [illegible] shiny objects in their [illegible] and take [illegible]

Unlike the [illegible] these [illegible] [illegible] and die. They return to the same streams of their birth at the end of their life cycles. The [illegible]

This 55-pound King Salmon Didn't Get Away

[illegible]

females dig shallow nests in gravelly stream bottoms and deposit their eggs. The males fertilize the eggs with milt. The females then cover the nests by brushing gravel over them with their tails. When spawning is completed, both males and females are so weakened that they drift downstream and die.

Salmon Return to an Artificial Home

The unerring homing instinct of salmon was demonstrated dramatically at the University of Washington School of Fisheries recently. In the fall of 1948 eggs taken from silver salmon were fertilized and placed in tanks at the University in Seattle.

Eighteen months later fingerlings hatched from these eggs were marked and released in concrete pools constructed near the Lake Washington Ship Canal, which passes the front of the fisheries buildings. A temporary fish ladder was built to enable the fingerlings to get out into the canal. From the canal fresh water is piped into the pools.

The released fingerlings swam down the ladder, passed through the canal, crossed fresh-water Lake Union, and went through the locks into Puget Sound.

In the fall and winter of 1951, 75 mature silver salmon, unmistakably marked, threaded that difficult way back to the artificial pool in front of the fisheries buildings. There their eggs were removed and fertilized to complete the cycle.

This successful experiment proves that it is possible to "plant" salmon in streams where they have not been known previously. A program of stocking tributaries of the Columbia below the power dams has been under way for several years (page 691).

In talks with heads of the big fishing companies at Astoria I found that opinion on the effects of dams on salmon runs is divided. Some of the fisheries men are bitterly opposed to construction of dams. One successful independent operator told me he has no quarrel with the dams and expects the new stream-stocking program to keep the salmon industry going.

Of the $20,000,000 annual income from fishing at Astoria, somewhat less than half is derived from Columbia River salmon. The rest comes from tuna, bottom fish, and other species taken offshore.

"Trees Forever," Timbermen's Slogan

One day I went with chief forester Clarence W. Richen of the Crown Zellerbach Corporation through the tree farms an organization operates near Astoria. By fire protection, selective logging, reseeding from helicopters, and planting of seedlings, Crown Zellerbach is insuring a permanent supply of timber. The big timber operators realize that their future depends upon sustained-yield logging and they are spending no expense to keep forests growing.

On our way back to Portland we passed through a part of the famous "Tillamook burn," where a forest fire destroyed 245,000 acres of virgin timber in 1933, and subsequent blazes took 55,000 acres more. Disaster recurred again in 1936 and in 1945.

Now the Oregon State Board of Forestry is engaged in a campaign to rehabilitate the area. School children help plant seedlings (opposite page).

To protect their own green forests from fires that might start in the whitening stumps still standing on the burn, Crown Zellerbach has bought large sections of the burn and removed thousands of dead stumps.

Unfortunately, little cutover land except that lying along stream bottoms is good for general agriculture. Growing trees as a crop is the one sure way to derive value from it.

One crisp Saturday in November Mr. and Mrs. McNeil and I took the 60-mile drive to Timberline Lodge, high on the slope of Mount Hood. Fresh snow had fallen there though the lowlands were still green, and late flowers lingered in Portland gardens.

On Sunday 3,000 skiers were ascending the mountain on the mile-long chair lift and rope ski tows and coasting down with the speed of the wind past the half-buried ground-floor windows of the lodge. Children were tobogganing down a steep slope in front of the great log and stone building.

The view over untouched forest from the window of my room was unforgettable. Below me the dark-green timber swept away down the side of Mount Hood and up facing steeps to a skyline etched with the snow-capped peaks of Three Fingered Jack, the Three Sisters, and other giants of the Cascades.

A Stone That Pops Like Popcorn

When I drove from Portland south to Salem to see S. H. Boardman, I found him enthusiastic as ever about new parks. At present he is advocating establishment of a State park to contain 40 miles of white water on the Deschutes River in central Oregon.

He told me about an unusual mine near Maupin in the desert country north of Bend.

A day or two later a mining expert and I drove over the shoulder of Mount Hood and down to a village in a deep canyon of the Deschutes. We crossed the river on a hand-operated ferry to a mining community carved out of the side of a mountain. Some 1,500 feet almost straight up from the mining company offices is an outcrop of pearl gray stone.

"That," said the mine manager, "is perlite."

School Children, Planting Douglas-fir Seedlings, Help Reforest Tillamook Burn

[illegible]

A Witches' Brew Turns Wood to Pretty Pulp at a Paper Mill

Rock Is Washed Off Logs by Powerful Jets of Water

[illegible]

[illegible]

[illegible]

Bonneville Dam, 42 Miles above Portland, Harnesses the Columbia's Power

[illegible]

Ten Mighty Turbines Generate Half a Million Kilowatts of Electricity

[illegible] Hoover Dam [illegible] Nevada [illegible] Mohave [illegible] Arizona [illegible] Colorado [illegible]

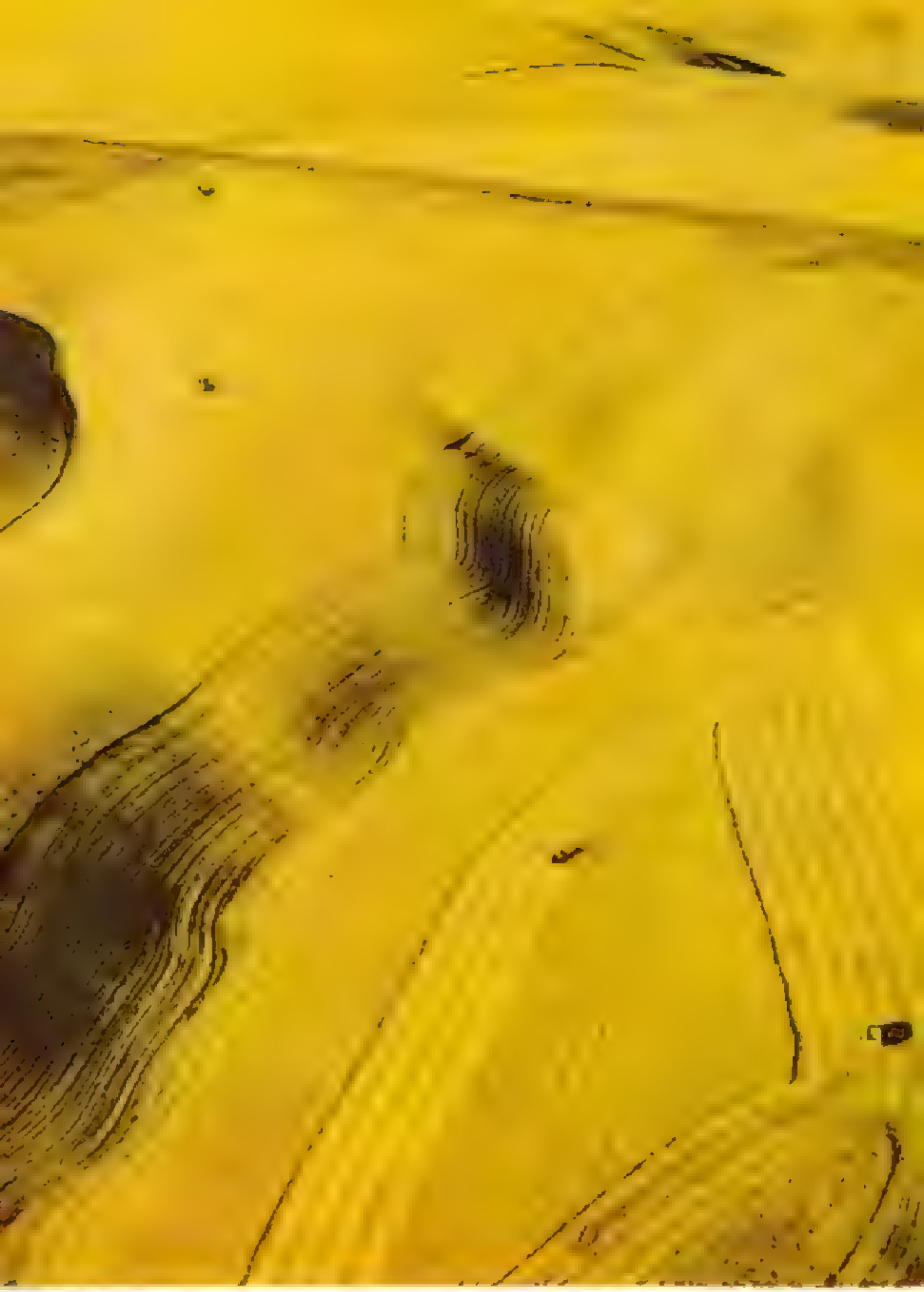
Portland Goes Fishing When the Smelt Run Hits the Sandy

Science Helps Nature Produce More Food

Columbia River Reels Toward Mount Hood Between Oregon Lava Cliffs (Left) and Washington Hills

[illegible]

A Leveled, Plowed, Seeded, and Equipped with Buildings and Livestock, This Farm Sprang from Desert in 24 Hours



Oceans of Winter Wheat Reaped by Fleets of Combines Roll over the Palouse Hills

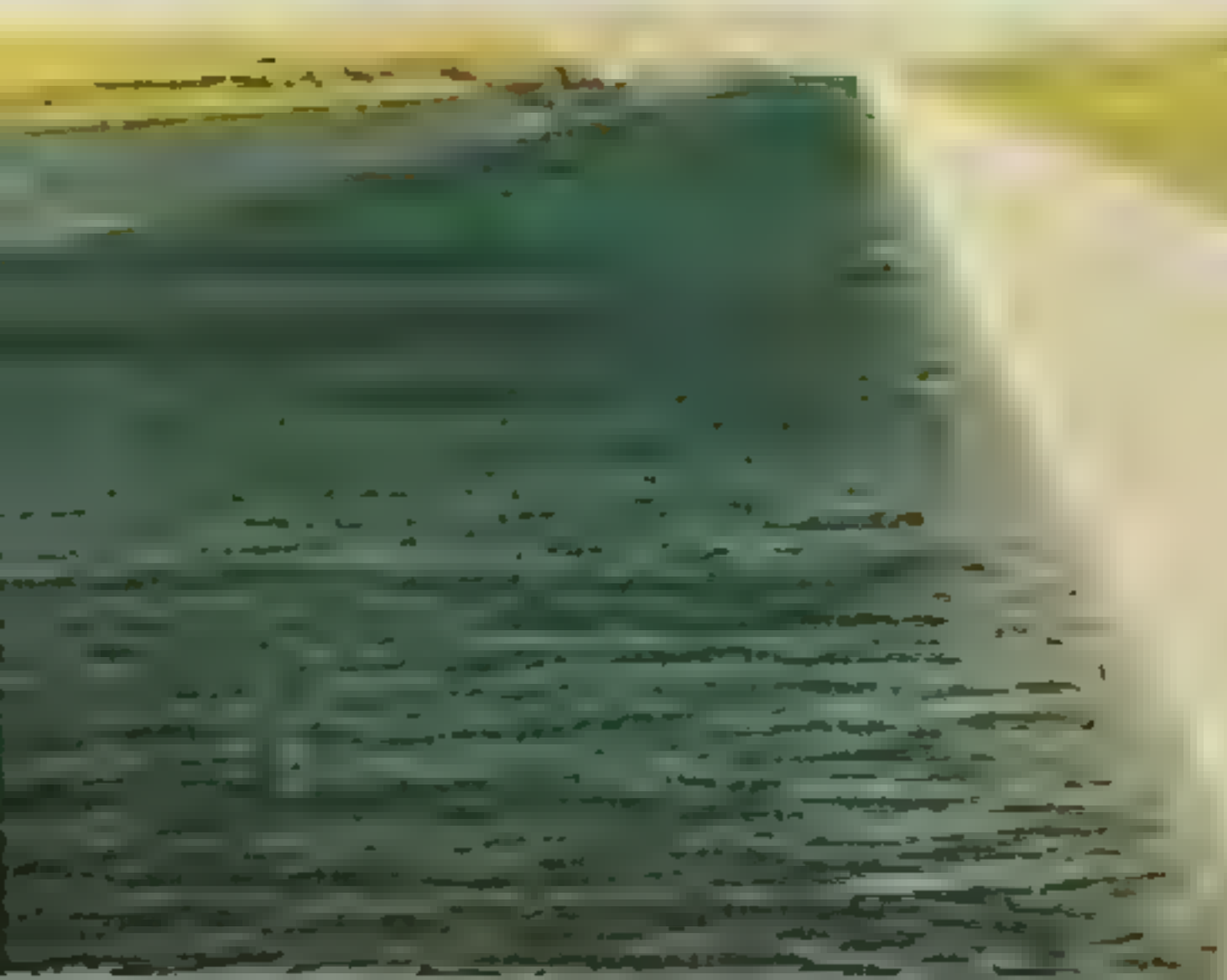
Fenceless Lands Yield Rich Harvests. Even Without Irrigation, Crop Failures Are Rare

Water Receives to Grand Coulee, Ancient Bed of the Columbia

[illegible]

23 Nations Take Part in Ephrata's Fair

[illegible]



Spokane River Thunders in a White Cascade Through the Heart of Its Namesake City

[illegible]

I climbed into a decrepit army truck with the manager, and we chugged up the perilous height by twisting switchbacks.

Carrier scoops were bringing tons of ore to a crusher near the mouth. In this crusher the rock was broken into pieces about as large as walnuts.

By successive flights of descending stairs we went through the mountainside plant. On each level, crushers were grinding the ore smaller till pieces were the size of wheat.

Now an astonishing thing happened. The grainlike substance was put into furnaces and subjected to a blast of flame at 1,900° temperature. The kernels of stone popped like popcorn, to emerge a fluffy meal.

"The perlite up at the mine weighs 85 pounds to the cubic foot," the manager told me. "This stuff weighs less than seven."

From the popped perlite lightweight plaster and acoustic tiles are made. The product saves thousands of pounds of weight in building construction, and acoustic tile made of it is one of the most effective sound deadeners ever discovered.

The mining expert who had accompanied me explained that, according to one school of thought, perlite stone is a rhyolite which poured from a volcano in molten state ages ago and cooled quickly in some prehistoric lake. Quantities of water were imprisoned in it when it crystallized, and it is this stone-locked water that expands under terrific heat and causes particles of the ore to pop.

Columbia River Has Made Portland

One day I asked Arthur Farmer, Portland civic leader, "What do you think most important in the development of this city?"

"If we ever get around to building a civic monument," he replied, "we might to dedicate it to the engineers who dredged the Columbia and Willamette Rivers and gave us a harbor for ocean-going ships.

"We used to be an inland town with no chance for world markets. Now with our 35-foot channel we are trading with Alaska, the Orient and the rest of the world."

Great steamers from afar now come into Portland harbor in ever-increasing numbers. Though the channel of deep water is wide enough for them to turn around on their own power, the port provides tugboats to help them maneuver when their boilers are cold. Most efficient of these boats is the *Portland*, a Mississippi River-type stern-wheeler (page 591). It is strange to see the antebellum-looking craft pushing around the most modern ocean liners.

The shipyards which made Portland boom during World War II are closed down, but there has been no diminution in the tempo of the city. With new industries springing up every day, there is work for everybody. Portland has never been a boom town save for a few years during the war. Primarily it is a pleasant home-town place of steady, healthy growth and leisurely habits.

People find time to cultivate and enjoy fine lawns and flower gardens. On the hillsides, houses ranging from mansions to bungalows are built with picture windows framing Mount Hood.

To me the friendly city is one of the most delightful in America. Most of the factories are run by electricity and consequently the air is usually free of smoke. Business is brisk, but people always have time for visitors.

Portland Parades Half a Million Roses

For sheer beauty there are few spectacles to compare with the Portland Rose Festival (page 594). I sat enraptured in Multnomah Civic Stadium on June 13 as 45 flower-decked floats, interspersed with a score of bands, moved up the ramp in the two-hour parade of the 44th annual celebration of this event.

On the theme "Childhood Memories," entries ran the gamut from *Mother Goose* to Hi de stories. The winning float represented a circus parade. It consisted of five sections with ringmaster, cages of animals and calliope, all done in red and white roses. More than 70,000 flowers were woven together to decorate the float.

An exquisite pageant of Cinderella going to the ball in her magnificent coach-and-four was done in white daisies and pink roses. Blue flowers edged the carriage wheels and the harness. This float with 50,000 flowers was adjudged second in the competition.

Never before have I seen such masses of flowers. A conservative estimate would place the number of blossoms on the 45 floats at half a million. Most remarkable to me is the fact that virtually all these flowers are grown in Portland gardens.

The day after the main parade, 10,000 school children marched in a Junior Rose Festival. Their floats, pulled mostly by hand, were small models of some of the finest displays of the grownups' parade. Unfortunately rain poured incessantly on the procession, and make-up ran down the cheeks of the child actors. Costumes were soaked, but the youngsters were game.

I boarded a plane at the airport just as sunset. As evening shadows lengthened, I saw lights come on in the valley, but the snowy crown of Mount Hood still glowed in golden sunlight (pages 592-593).

On the cover of a folder someone had left in the seat next to mine was the caption, "For You a Rose In Portland Grows."

Our Navy's Long Submarine Arm

Snorkel-equipped Prowlers Bring a New Era, and the Navy's Sub Now Being Built Promises a Far Greater Undersea Revolution

By Allan C. Fisher, Jr.

"TAKE her down!" *Ah-oom-gah! Ah-oom-gah!* Two blasts of a raucous horn signalled the command. Men who had been stationed on the bridge of the U. S. S. *Subdefish* plunged down the conning tower hatchway like rabbits jumping into a hole. The last man slammed and locked the hatch.

For nearly an hour our submarine had been cruising on the surface off New London, Connecticut. Now, with the sounding of the diving alarm, we were about to submerge for a test of her snorkel, the ingenious breathing tube that enables today's deadly steel sharks to remain underwater for weeks at a time.

Three Weeks Under the Sea

The snorkel, a Dutch invention perfected by the Germans, luckily was not quite ready to be unleashed against Allied shipping in World War II. Simple in principle, it consists of two pipelike cylinders. One sucks in air from the surface, while the other expels engine exhaust into the water.

"snorkel," a postwar addition to the dictionary, is generally supposed to come from the German *Schnorkel*, meaning spiral or twisted ornament. Another version is that it stems from the colloquial German word *Snorchel*, meaning animal's snout. The British call the device a "snort."

Until the snorkel revolutionized submarine warfare, Diesel engines, requiring air, could not be used when the boat was submerged. To recharge batteries needed for underwater propulsion, the submarine had to surface frequently. Now, with the snorkel, Diesels can be run at periscope depth. Batteries, still needed for deeper operation, can be charged without venturing up to the open air.

Thus the modern submarine can stay submerged for many days, greatly increasing its chances of avoiding detection. World War II subs, when surfaced, often were easy radar targets. The snorkel breathing-tube head, however, is no bigger than a cottage chimney. It is hard to detect, particularly in a rough sea.

One of our Navy's snorkel submarines, the *Pickerel*, has cruised all the way from Hong Kong to Pearl Harbor, Hawaii, without once coming to the surface in 21 days and 5,600 miles. Although the cruise proved the new elusiveness of the submarine, it was undertaken primarily as a test of equipment and, above all, men.

"Snorkeling" creates serious physiological problems for crewmen. The air-intake valve, when struck by a wave, closes automatically to prevent flooding. But the Diesel engines keep gulping air like a vacuum pump until the snorkel is clear and its valve reopens.

This results in rapid variation of air pressure within the submarine. Crewmen sometimes experience an uncomfortable ear-popping, head-filling sensation, though in time they become conditioned to it and simply ignore the occasional discomfort. I was to find out for myself what a headache snorkeling can be.

20 Minutes Enough for a Landlubber

As the *Subdefish* nosed under, I could feel the deck tilt slightly. There was no other sensation to indicate we were slipping beneath the waves. Once submerged, nothing I could detect suggested our forward motion.

Climbing to the conning tower, I joined Comdr. Julian T. Burke, the sub's skipper, at the periscope. Above us the day was overcast and mild, with just enough sea swell to give the air induction valve a good workout. An order sent the hydraulically operated snorkel tubes to the surface.

"Now watch the altimeter," Burke said.

In a fraction of a minute the gauge needle swung to 800 feet. A command for more power went to the engine room, and the needle crept higher, to 900 feet, 950, then 1,000. Our huge Diesels were eating up air within the submarine, whisking us from sea level to rarefied mountain atmosphere.

When waves closed the snorkel valve, the altimeter raced higher and the temperature in the submarine became noticeably cooler. When the valve opened, the needle fell and the air turned humid.

My ears ached like a bad tooth until Burke suggested, "Hold your nose and blow. It will open up your head."

A Destroyer Escort Lays Down a Rosette of 17 Depth Charges

In two world wars depth charges had a demoralizing effect on U-boat crews. Depth charges shook submarines violently, though they often failed to destroy their targets. The hedgehog, a newer weapon, has proved more effective (page 630)

Moonlighters at Annapolis Tour U.S.S. *Triggers*, a Deadly New Attack Submarine

[illegible] Streamlined hulls [illegible] use them instead the speed which [illegible] *Triggers*, one of six new attack type [illegible] ly travels faster beneath the [illegible] than on the surface.

[illegible] 10 more minutes the altimeter seesawed back and forth, like an erratic compass. Finally Burke said:

"Guess that's enough. The [illegible] below deck are probably blessing us [illegible] sometimes difficult to swallow while the [illegible] are [illegible]."

It is also [illegible] to sleep, Navy [illegible] told me later. [illegible] awakened by [illegible] and shaves.

Twenty minutes of this proved enough for me, and I regarded with added respect the men of our undersea fleet.

Both a Weapon and a Threat

In four weeks of watching submariners in action, from Connecticut to Key West, Florida, I saw how fleet-type subs of World War II, though still effective, are destined for the fate of the Model T Ford. Newer and even better types, streamlined and capable of high submerged speed, are joining the fleet. Some are conversions from old vessels. Others have been constructed from the keel up and embody a host of innovations. [illegible] equipment.

I saw, too, something of our countermeasures, including deadly little submarine-killer subs, for the snorkel is a two-edged weapon [illegible]

"We [illegible] potential enemies cannot [illegible] supremacy at sea," said Admiral William [illegible] Fahrtler, Chief of Naval Operations, in a lecture before members of the National Geographic Society last February in Washington, D. C. "I refer specifically to the submarine threat."

We came perilously [illegible] World Wars I and II by reason of Germany's unrestricted submarine warfare in the North Atlantic.

Germany commenced World War II with [illegible] 50 submarines of relatively low speed and poor operating characteristics. The Germans rapidly improved their submarine design [illegible] war progressed.

[illegible] today has between three and four

Crewmen Let Down Banks and Watch a Mine as Torpedo Forward Torpedo Room

[illegible] Gun, pivoting is equally [illegible]

[illegible] commerce. We do not know what the characteristics of these submarines may be, but we do know that after the war Russia obtained some of the most modern of German [illegible] the east. Let us [illegible] that the Russian [illegible] of ships which are not [illegible] the original German [illegible] at least equal [illegible] Latest and most [illegible] German design.

"We have made great progress in [illegible] the submarine threat," Admiral [illegible] and [illegible] "[illegible] losses, particularly in the early days of a conflict."*

Strange though it may seem in view of the [illegible] one capable of operating indefinitely [illegible] the atmosphere [illegible] types are better described as [illegible] torpedo boats, for they can remain below [illegible] depth [illegible]

First "True Sub" Now Possible

Although the [illegible] the submarine is always [illegible] sub, [illegible] Electric Boat Division [illegible] Dynamic [illegible] 6551).

Meanwhile, the fuel which would be burned [illegible] for its [illegible] Submarines thus could cruise indefinitely at great depth. The [illegible] limited only by the crew's endurance and their supply of oxygen for breathing.

* [illegible]

"Congratulations on Your Promotion!" Sailors Seem Fit to Be Tossing Shipmates Overboard

When a seaman attains rank as chief petty officer, [illegible] leave him from deck into harbor. The practice, formerly widespread, [illegible] are still the [illegible] West Florida witnessed the durable [illegible]

Energy particles released by atomic fission give off tremendous amounts of heat. Present plans call for harnessing this heat to a steam turbine in the atom sub. A new heat [illegible] coolant, possibly a liquid metal, would be used to prevent excessive contamination of steam condensate [illegible]

Atom Sub's Fuel May Last a Year

It has been estimated unofficially that the first nuclear-powered submarine probably will be capable of making 35 knots submerged—considerably faster than the top speed of our latest-model subs and of most surface warships.

Since the energy packed into uranium is dissipated at a very slow rate under controlled conditions, a boat thus powered would need refueling only once a year, or even less often.

Meanwhile the Navy is steadily improving its Diesel subs. Former submariners now in civilian life would hardly recognize their old World War II craft after conversion into the new streamlined beauties called "guppies." Deck guns and cluttered bridge are gone, replaced by a single rifle-like fin topped by snorkel and periscope (page 270).

Before remodeling, these craft could cruise only eight or nine knots submerged. Navy spokesmen are guarded about their new speed, but it is considerably faster.

In addition to [illegible] program, our Navy is remodeling some World War II submarines as prototypes of special [illegible] vessels. Among them are oilers, troop and cargo carriers, mine layers, radar picket boats, and guided-missile launchers. They would be used in enemy-controlled waters where surface ships, preferably [illegible] could not venture.

During the war Germany's high command conceived the idea of a submersible raft which could be towed by a U-boat across the Atlantic. While still well out from shore, raft and U-boat would surface to fire a buzz bomb on New York City. This ambitious plan was

USS *Perch*, a Troop Carrier, Plows Through Famous Ice in Alaskan Waters

Submarines can take troop [illegible] ted waters where surface ships dare not venture [illegible] ice floes [illegible] ice floes and rafts (page 631). Here crewmen chip ice from *Perch's* rolling deck during cold weather maneuvers.

never tried, but it proved the progenitor of our own missile-launching submarines.

The *Loon*, an improved American version of the German buzz bomb, was first fired from a submarine in 1947 off Point Mugu, California. New and better guided missiles are in the planning and testing stages. Submariners envisage a day when, if necessary, they could shower these long-range weapons on enemy concentrations, or even direct them against aircraft.

Small Boats with Big Ears

Our specially armed "submarine-killers" [illegible] were developed for the specialized job of ambushing enemy undersea craft.

Three "K-boats" have been built. Chubby and only 195 feet long, they little resemble the sleeker, 311-foot fleet type. All three will carry supersensitive electronic "ears" to detect their quarry and improved torpedoes to finish him off (page 636).

One such weapon, the homing torpedo, operates on an acoustic principle. When released, it runs unerringly to the target, guided only by the enemy's sound. A second type, the pattern-running torpedo, heads for the target area and then begins to weave through the water, seeking a victim.

Of the killer's mission, Rear Adm. Charles B. Momsen, commanding Pacific Fleet submarines, says: "There is no foe that strikes more terror in the heart of a submariner than an enemy submarine lurking in the same waters."

Six new attack submarines—the *Tang*, *Trigger*, *Trout*, *Walrus*, *Harder*, and *Gudgeon*—also are being built (page 614). They are the first we have produced which are capable of going faster submerged than on the surface. Like the K-boats, these deadly raiders are shorter and sleeker than the fleet type. Naval architects redesigned the interior to obtain more room for secret electronic equipment and high powered batteries.

"They were built to give our anti-submarine warfare boys a real workout," said a Navy

spokesman. "They, too, will carry the new, improved torpedoes."

"We've come a long way in submarine development," he added, "but without highly skilled crews these boats are no more lethal than a child's cap pistol. Our men are specialists, and we train them constantly."

Volunteers Man the Undersea Fleet

My acquaintance might have prefaced the word "specialist" with "carefully selected" for all of our submariners are volunteers who must meet rigid standards. Because of the hazardous nature of their work, they receive as much as 50 percent extra pay.

By official Navy edict, the sprawling, 500-acre submarine base on Connecticut's Thames River calls New London its home. Actually the address is a postal rather than a geographic fact. Long wooden piers and busy repair shops line the Thames above Groton. New London lies across the river.

On a hill overlooking the water front are the campus-like lawns and modern buildings of the U. S. Submarine School and Medical Research Laboratory.

Every officer in the submarine force, and nearly all the enlisted men, are graduates of this school, the only one in the Navy for the training of submarine personnel (pages 621, 630, and 631).

Because of the secrecy which veiled its wartime operations, this branch of the Navy earned the nickname "the Silent Service." Hence, the New London base has become popularly known as the "Annapolis of the Silent Service."

Gilmore Hall, [illegible] administrative offices, is a living memorial to the 374 officers and 3,131 enlisted men who were lost in submarines in World War II. It bears a proud name, that of Comdr. Howard Gilmore, Medal of Honor winner.

His submarine, the *Growler*, was badly battered in 1943 during a surface battle with the Japanese. Lying wounded on the deck, Gilmore ordered his men to "Take her down!" Though her captain was lost, the *Growler* lived to fight for nearly two years more until listed as missing in action.

This sign above a doorway greets all students entering the building:

> THEIR WANT OF PRACTICE WILL MAKE THEM UNSKILLED, AND THEIR WANT OF SKILL TIMID. MARITIME SKILL, LIKE SKILLS OF OTHER KINDS, IS NOT CULTIVATED BY THE WAY OR AT CHANCE TIMES
>
> —Thucydides, 500 BC

"That saying is just as true today as it was nearly 2,500 years ago," said Rear Adm. Stuart S. Murray. "It sums up the whole purpose of our training program."

Admiral Murray, who commanded Atlantic Fleet submarines at the time of my visit to New London, is now Commandant of the 14th Naval District and Commander of the Hawaiian Sea Frontier.

It isn't easy to enter the submarine school—and it is even more difficult to remain.

"Our applicants—and there are more than we have vacancies—come from other branches of the Navy," I was told by Capt. William R. Siegloff, school commandant (now commander of the base). "All are rigidly screened for physical, mental, character, and personality qualifications, as well as naval skills, before they ever arrive."

Officers take a six-months' course in such subjects as engineering, ordnance, tactics, communications, and submarine construction and operation. Enlisted men go through a rigorous eight-weeks' training period, part of which is dubbed the "School of the Boat." They must become thoroughly familiar with each compartment in a submarine and know their own particular station as intimately as they do the faces of their wives and children.

"We believe a man retains more of what he sees and does than of what he hears," Captain Siegloff said. "So our course is about one-third in classrooms with lectures, one-third in training devices and equipment, and one-third at sea."

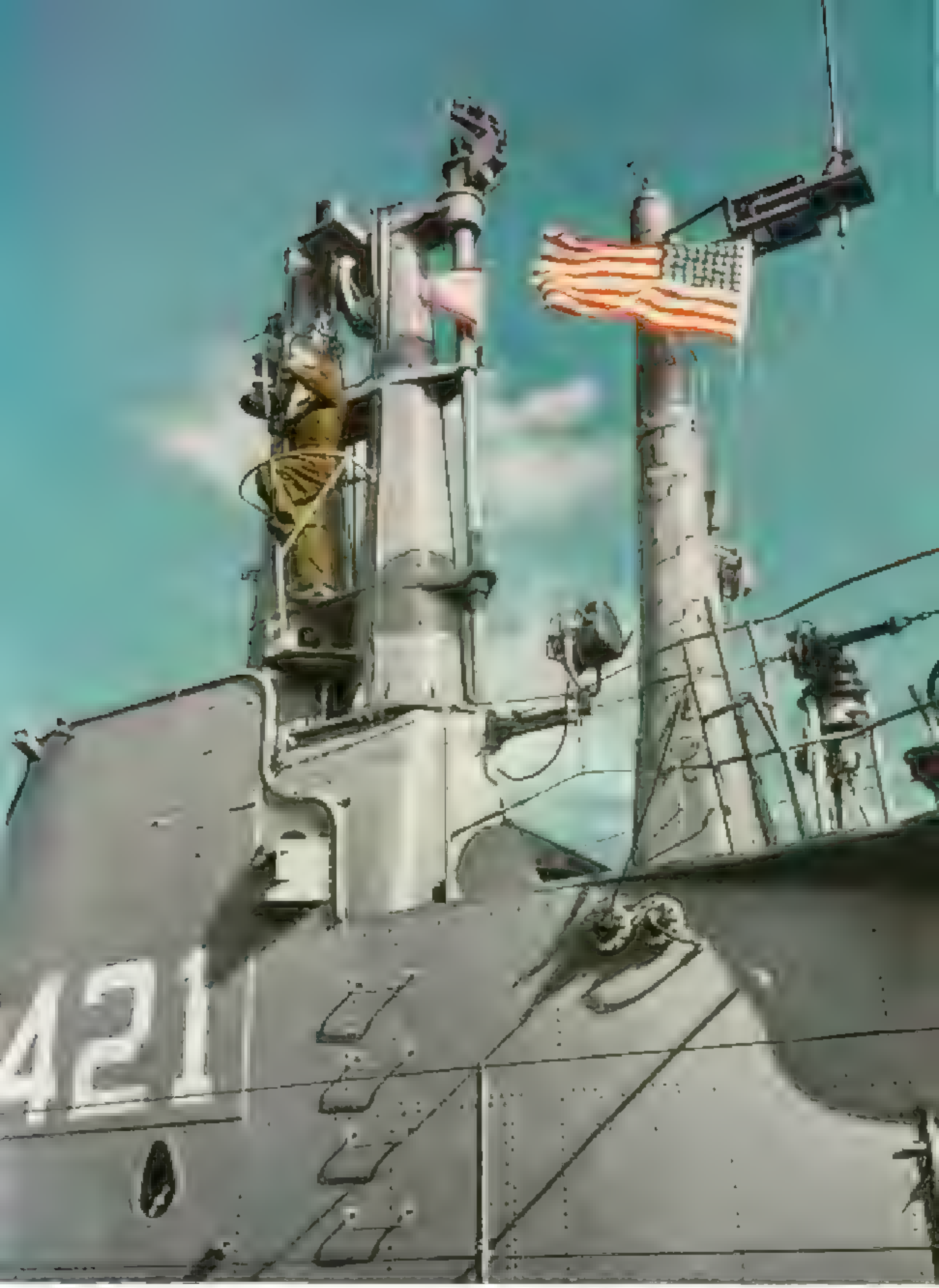
Since the school was established in 1917, more than 5,000 officers and 50,000 enlisted men have taken the basic training. There are also advanced courses, in which a captain may find himself rubbing elbows with a [illegible]

Touring the school, I watched three enlisted men operate an exact replica of the bow and stern diving controls found on a submarine. Their cubicle tilted realistically as the men twirled wheels and levers. Behind them an instructor created problems of course and depth, correcting the men when they failed to maintain proper angle and balance. Nearby other enlisted men shifted huge levers controlling the speed of battery fed motors and twin 1,600-horsepower Diesel engines.

Training for Escape

Despite many safeguards, diving a submarine remains a dangerous business. Collision, a crew member's mistake, equipment failure, any of these may cause a sub to flood and sink. If this happens, some men may be trapped underseas in undamaged, watertight compartments.

To teach its students how to save their lives should disaster strike, the New London school built one of the most unusual classrooms in



U. S. S. *Fenton's* Lookout Scans the Sea for Approaching Ships

A Sleek Guppy Sub Cruises Off the Florida Keys

[illegible]

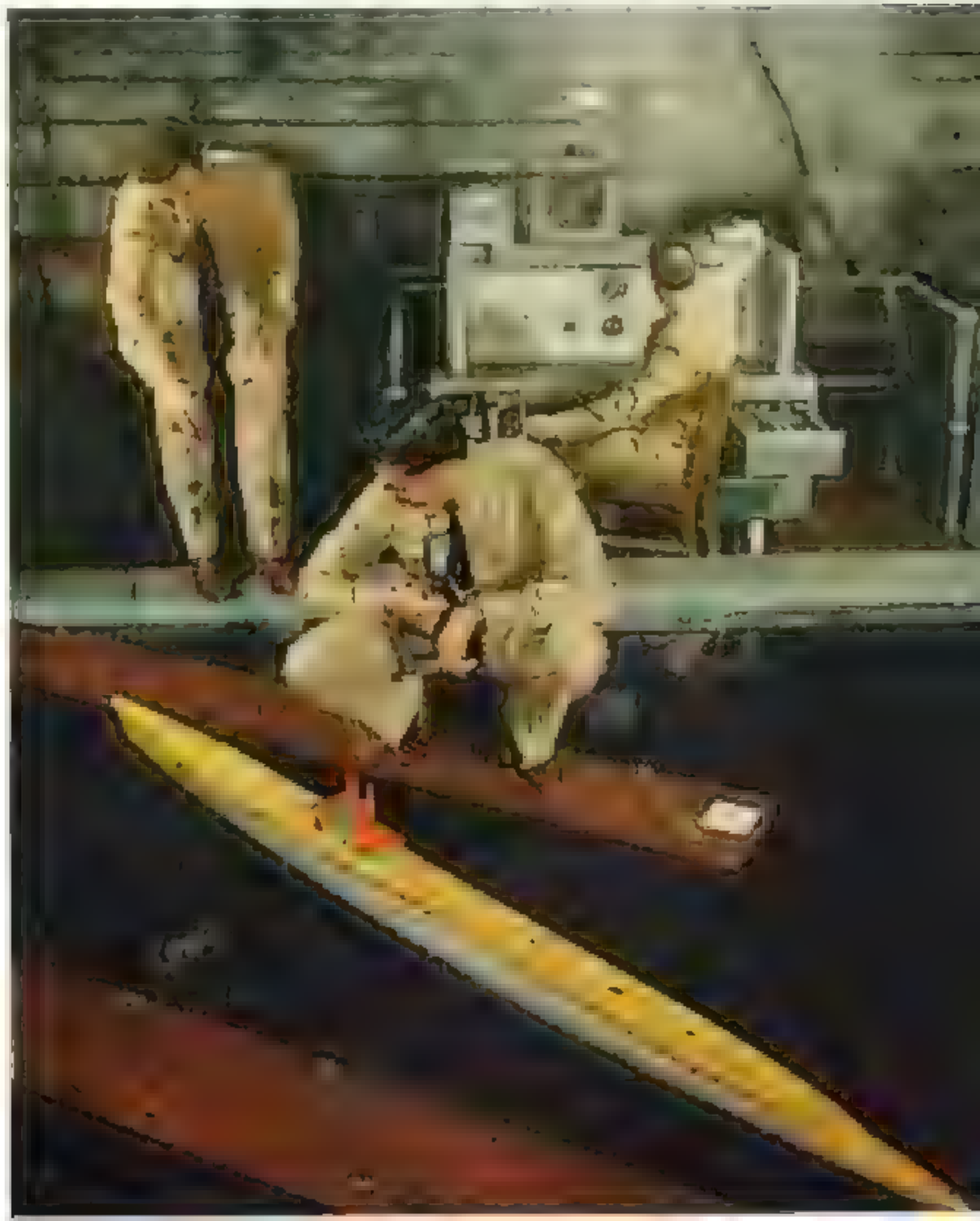
[illegible]

[illegible]

[illegible]

[illegible]

Color Spectaculars Mix New Forms for Sub Interiors . . . A Radio-controlled Model Moves Toward a Miniature Line



"We Eat the Best Food in the Navy," Submariners Boast

Lanter's Controller and Crew Takes Her Down as a Practice Dive. Submergence Requires Less than a Minute

U. S. S. *Seafarer* Tests Her Deep Submergence Rescue Chamber

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Hungry as Sharks, Scavengers Page to the Surface of a Training Tank 100 Feet Deep

[illegible]

Danny Hedges Scooter Around a Submerged Sub

[illegible]

the world, a huge, silolike escape-training tank filled with 100 feet of water.

On each submarine there are two escape hatches, one at either end of the boat. The training tank duplicates these hatches in specially constructed locks at the 18, 50, and 100 foot levels (page 625).

Enlisted students must make an ascent from 50 feet, and officers from 100 feet, in order to qualify for the service. They wear a weird-looking appliance resembling a gas mask.*

Once charged with oxygen, it enables a man to breathe normally underwater for an average of 10 minutes. A special filter removes carbon dioxide, and a flutter valve permits excess oxygen to escape.

On the day I visited the tank, a group of advanced course trainees were learning a newer technique, the "free escape" without artificial breathing aid.

The hazards involved in this method causes Navy officials to suspend it from the curriculum not long after I left New London.

From an enclosed platform atop the tank I watched men drift slowly up through the floodlit water without moving a muscle, relying only upon the buoyancy of lungs and body.

Lungs May Burst Like a Balloon

"You rise to the surface simply by exhaling air from the lungs," said Lt. James Hog, officer in charge of the tank. "If you don't get rid of enough air on the way up, it's possible to rupture the tissue of the lung."

Hog explained that air within the locks (or within a sunken submarine) must first be adjusted to the outside water pressure before the escape hatch can be opened. Men making a free escape fill their lungs with compressed air before entering the water.

An adult male's lung capacity at atmospheric pressure is about 5,000 cubic centimeters. A submariner leaving the 50-foot lock level has two and a half times that much compressed into the same volume. As he rises, the air in his lungs expands.

I heard instructors warn the students that they would have to exhale constantly all the way up, or risk having a lung break like an [illegible] balloon. [illegible] were [illegible] that air emboli, resulting from rupture of the lung, could cause paralysis if they lodged in brain or spinal cord.

Just such an accident occurred minutes after I left the tank. The man was rushed to the tower's recompression chamber. Air pressure was increased until the bubble literally was squeezed to nothingness, relieving the paralysis. Navy physicians said the man would recover.

More recently, however, there were two training tank fatalities from air emboli. As a result, free escapes now are made only on an experimental basis.

The technique, though dangerous, serves an important purpose. It teaches men how to save themselves in the event they cannot find an escape appliance during a disaster, or if they lose their rubber mouthpieces while ascending.

More than 300,000 safe ascents have been recorded in the New London tank, most of them made with the appliance. Safety precautions are stringent, and a doctor is always in attendance. But, unfortunately, there is as yet no positive way of determining whether a man is expelling sufficient air while making a free escape.

Diving Bell to the Rescue

Individual escapes are not possible at great depths or in extremely cold water. If circumstances permit, the best method of rescuing trapped men is with the Navy's ingenious submarine rescue chamber, an 11 ton diving bell. This device was used to bring 33 men from the *Squalus*, which sank May 23, 1939, off Portsmouth, New Hampshire.

Wherever United States submarines operate in peacetime, rescue chambers are near. They are carried on the decks of small oceangoing vessels equipped for rescue and salvage operations at sea. Some of these craft are specially designed for the work; others are converted tugboats.

"Event 1000," the Atlantic Fleet's code signal for a submarine disaster, speeds these mercy vessels and other auxiliaries to the scene.

Early-morning sunbeams were dancing on the Thames when I boarded the tug *Skylark* to witness a simulated rescue operation at sea. Our destination was Block Island Sound where the chamber—or bell, as the crew calls it—would be put overboard in 70 feet of water.

"We're going to make what we call a 'false [illegible]'," explained Lt. Comdr. Romolo Cousins, captain of the *Skylark*. "We will lower to the bottom an exact replica of a submarine escape hatch, then send the chamber down."

"Incidentally," he inquired, "would you like to make the trip?"

Somehow I managed a faint "yes," then wandered across the deck for a look at our bell. It proved to be a pear-shaped metal monster, 14 feet high. Inside its steel hull were two compartments. The upper, watertight, had air and electrical connections; the lower was open to admit the sea.

* For an account of the development and use of [illegible] for breathing under water, the Aqua[illegible] "Men Explore a New Undersea World," by Capt. Jacques-Yves Cousteau, in the NATIONAL GEOGRAPHIC MAGAZINE, October 1952.

Here's how the bell works: To descend, ballast tanks are flooded and a compressed-air motor reels the chamber down on a cable, which divers attach to the submarine. When the bell is on the escape hatch, water is blown from the lower compartment with compressed air. Operators then open valves which release the air into their own compartment.

Now sea pressure becomes an ally. Like a suction disk against a wall, the bell is forced down upon the escape hatch, making a watertight seal.

A small door to the lower chamber can then be opened and 10 or more men can be brought from the submarine. The lower compartment is closed and flooded, ballast tanks are blown, and the bell reels itself back to the surface.

A Trip to Davy Jones' Locker

Towheaded Bill Russ, a Navy diver, would march our deckhand aside. Three sailors helped him into his heavy canvas suit and lowered the glass-fronted, valve-studded helmet onto his head. Five minutes later he was over the side.

For training purposes, Russ was breathing a helium-oxygen mixture not ordinarily used at the relatively shallow depth of 70 feet.

Despite every precaution, divers face the occupational hazard of bends. If they return to the surface too rapidly, decreasing pressure may cause the nitrogen in their systems to bubble like champagne, with painful and sometimes serious results.

Comdr. Harry Alvis, a Navy physician, kept in constant touch with Russ through a ship-to-diver communications line.

"How are you, Russ?" Alvis asked.

The voice that answered was a perfect imitation of Donald Duck.

"Everything okay down here," it squawked.

"That's due to the helium in the mixture he's breathing," Alvis explained. "Helium is a less dense medium than air and changes the transmitted qualities of the voice."

Soon Russ was back on deck after attaching the cable.

"Time for your ride," Cousins announced.

Four men were to accompany me: Lt. Glenn Heller, Chief Petty Officers Frank Coupal and John Peterson, and Journalist First Class Dan Kelly.

Kelly, a quick-witted youngster with an active sense of humor, had been my guide and escort in New London. Now he assured me:

"I'm only doing this because my orders are to bring you back alive."

One by one we clambered over the ship's railing and dropped through the chamber's upper hatch.

Viewed from the outside, the bell had seemed huge (page 624). Now the five of us were encased in a tiny steel cell with just enough headroom to stand. Sloping walls were covered with pipes and valves.

The overhead hatch slammed shut. With a sudden lurch the chamber left the ship's side.

While Peterson called off a procedure check list, Coupal and the Lieutenant operated valves and confirmed each order. A loud-speaker picked up their words and relayed them to the surface.

"Blowing main ballast" . . . "Main ballast [illegible] . . ."

Suddenly a stream of dark water poured into the chamber from above, sloshing from my shoulder to the deck.

"Get the hatch!" Peterson shouted.

Lunging past me, Heller spun a metal wheel above us, securing the hatch cover. It had been unseated just enough to assure us a humid ride the rest of the way down.

"Are you all right?" Kelly asked me. I nodded, not trusting my voice.

Steadily the depth gauge hand crept downward—30 . . . 40 . . . 50 feet. Our compressed-air winch chattered noisily.

Finally we stopped at 70 feet.

Through a tiny, round window underfoot I could see the lower compartment begin to boil like a caldron as compressed air forced out the water. My ears ached as the pressure was suddenly vented back into our own steel cell.

Coupal opened the entrance to the lower compartment. There, about five feet below and plainly visible in the glow of our electric lights, was the submarine hatch cover.

We had made our "false seat."

"Ordinarily," Peterson explained, "we would bolt ourselves down to a submarine as a precautionary measure."

"That's it," said Heller. "Let's start back up."

Our return trip was smooth and uneventful. When we reached the surface, the *Skylark's* crew reeled in our slender guide line. For a few minutes we canted sharply to one side, bobbing on the waves, before we reached the ship's side.

Mistakes Can Be Fatal

After our 43 minutes in the bell, *Skylark's* small deck seemed spacious as a carrier. I breathed gratefully of the good salt air as the little tugboat headed for home.

Once New London students master their shore lessons they are sent to sea for intensive drilling in their specialties. Aboard the sub *Cavalla* I watched trainees operate the diving controls. A veteran crewman stood at

A Navy Helicopter, Stalking a Sub, Lowers Its Hearing Aid Beneath the Sea

[illegible] the Navy's word for underwater sound gear, is the most effective means of detecting submerged submarines. Engineers have developed compact gear which ship-based helicopters, hovering above the sea, lower on an insulated cable. Navy men call the new technique "dunking sonar" (page 64).

the side of each student to guard [illegible] in [illegible].

There are more than 40 operations in running a submarine," said Lt. Howard [illegible]. "Club any one of them and you may lose your boat. Whether you lose your shipmates or not, you must have faith in them.

After a period at sea duty, New London graduates win the prized service-record notation, "qualified in submarines." But qualification is only the first step in their rigorous training. Fledgling submariners, and veterans as well, polish their techniques through innumerable combat exercises.

To learn more about the training methods of our undersea Navy, I boarded the [illegible] *Bang* for a sub's-eye view of a grimly real mock battle, fought in the gray waters of the Atlantic off Newport, Rhode Island. Commander Lucas Henley, the sub's skipper, explained [illegible]

[illegible] 10 destroyers. *Bang* and [illegible] *Cobia* and [illegible] using [illegible] flares from [illegible] to simulate the release of torpedoes.

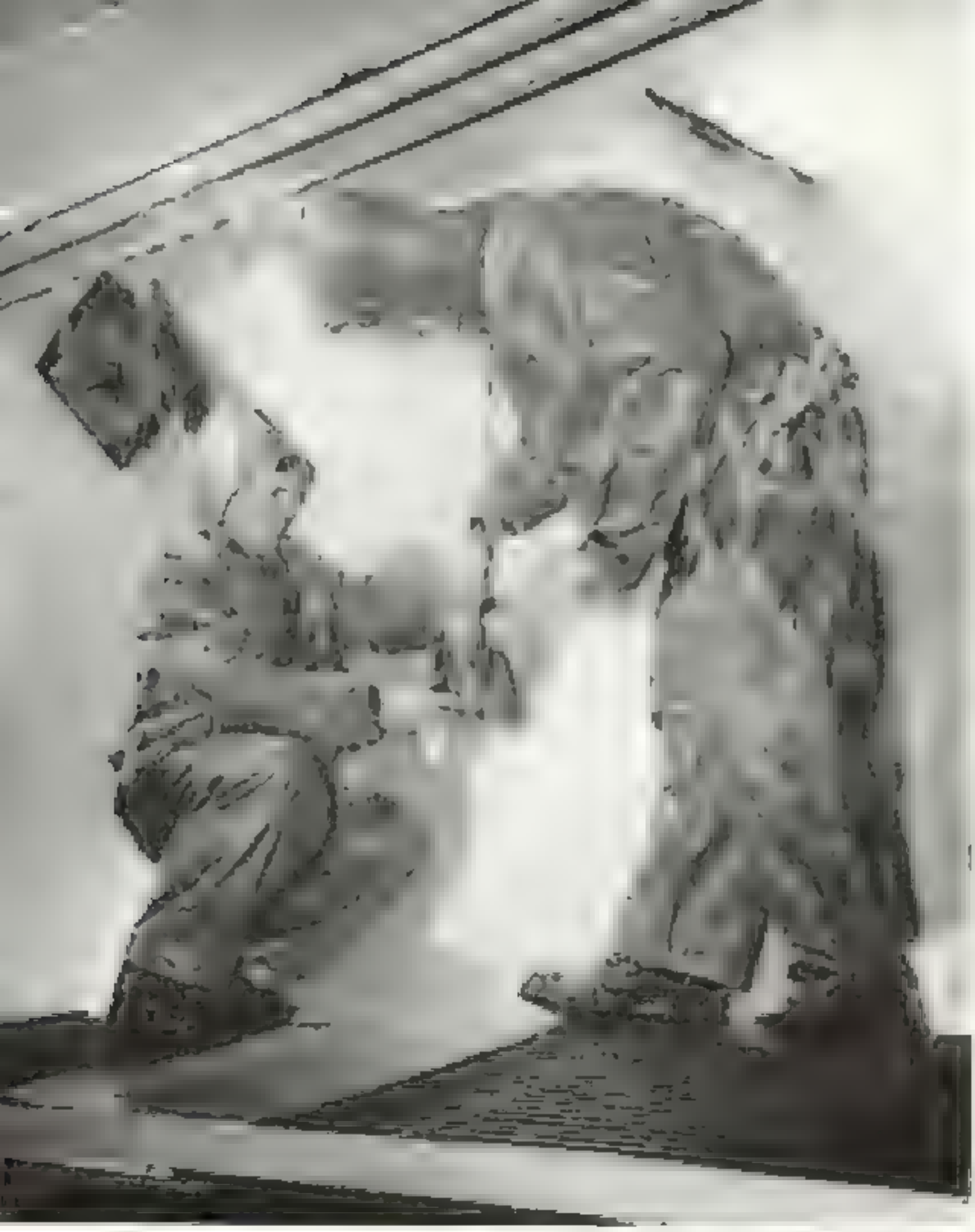
While we were leaving the harbor, Henley turned me over to crewmen for a pre-attack tour of the boat.

In "Enemy" Waters

Every visible nook and cranny on the *Bang* seemed crammed with pipes, dials, valves and equipment. A fleet submarine, though longer than a football field, is no place for victims of claustrophobia.

We inspected the officers' tiny, Pullman-like staterooms and small wardroom, the crews' comfortable bunks, the galley and mess room, and the torpedo tubes in bow and stern.

Upon nearing "enemy" waters, Henley gave the order to submerge. In the control room crewmen moved with quick precision, closing some valves against the sea and opening others



Student Submarineers Practice Lesson Hard

[illegible] the New London submarine [illegible] control [illegible] in the replica of a conning tower. Tapping a break, the crew [illegible] sailor [illegible] while the commander looks it up in place with a wrench

which flooded the diving tanks. One operator released compressed air into the boat while an intent officer eyed a gauge. It reacted promptly to the increase in pressure, indicating all hatch openings were closed.

Next by a chief petty officer scanned a panel of green lights. A red light on that panel would have warned of an open vent or valve which might flood a compartment.

Climbing from the control room to the conning tower, I learned that our quarry, now near by, had far too many solicitous [illegible]. Fleet vessels searched the water [illegible] like a pack of excited hounds.

The Hunter Becomes the Hunted

From a post by the helmsman I watched our conning tower crew plot the attack. Methodically, with the ease of long practice, [illegible] men busied themselves with [illegible] sound-detection equipment, and [illegible] fire-control gear, all in a space no bigger than a cluttered kitchen.

Twice during the hour which followed we barely escaped from patrol craft. Then, suddenly, the climax of this undersea drama was at hand.

"This looks like the main formation," Hensley said from the periscope. "One, two, three, four destroyers and a large ship astern."

"If they straddle us we'll be all right."

Moments later he suddenly announced:

"We're in a good position to get rammed here before the green flare!"

Bang eased down to a safer depth. Then my ears seemed to play a trick on me. The rapid *clack-clack-clack* of a locomotive, chuffing across a trestle, filled the conning tower.

My open-mouthed astonishment drew a grin from Lt. Comdr. Richard Phipps, the *Bang's* executive officer.

"Down here, that's what a destroyer sounds like," he said. "She just went over your head."

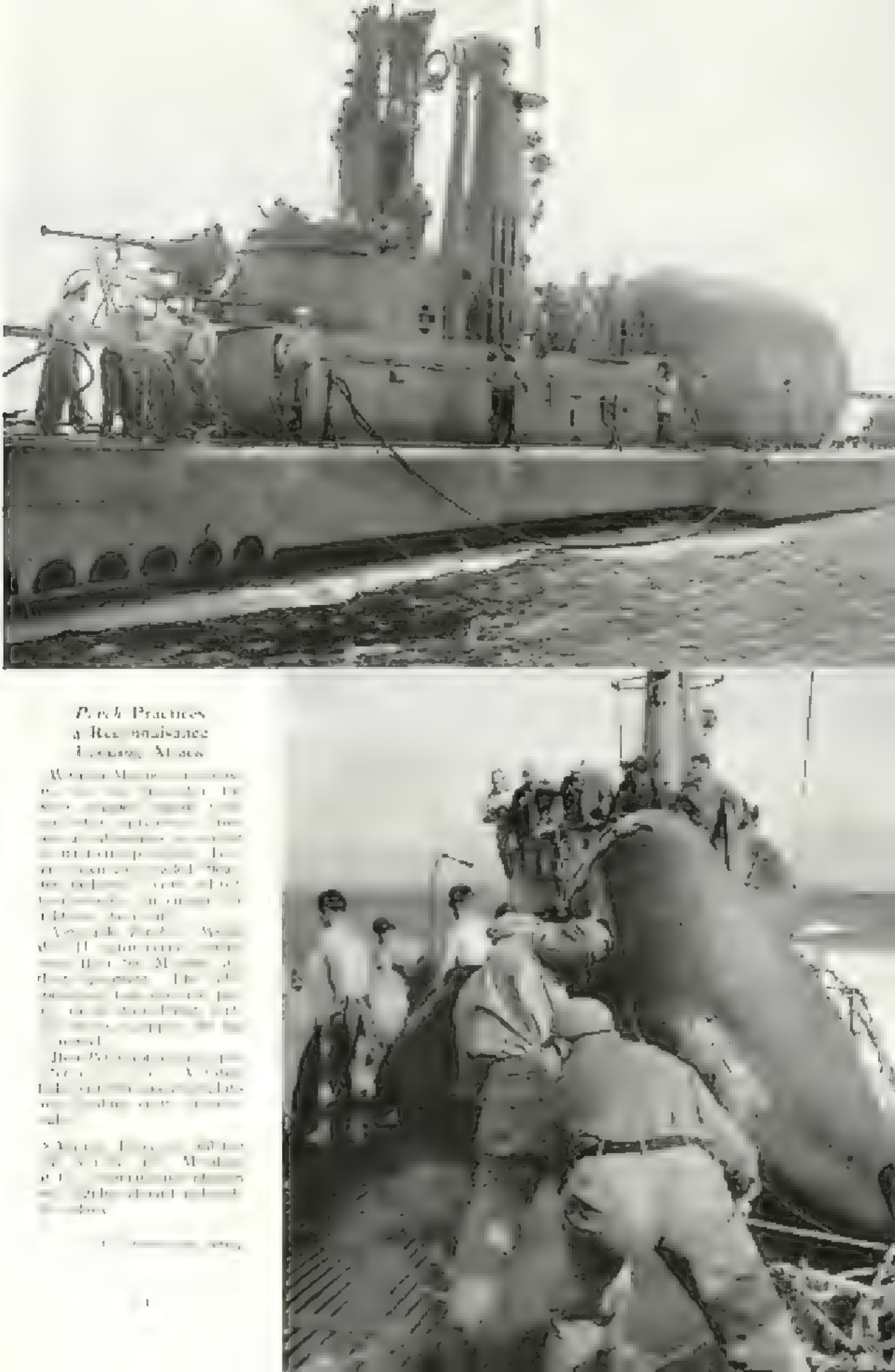
For the remainder of the contest we were pinned down deep. Several time[illegible] [illegible] our position [illegible].

Later, [illegible] I learned that our flare had ha[illegible] [illegible]. We, in turn, had been "killed" [illegible] scorts, and the *Cod* had [illegible].

But the *Cobia* found h[illegible] [illegible] got the carrier!

Within the spacious Medical Research Laboratory, physicians and scientists are constantly seeking better means to determine a man's fitness for submarine duty. Part of the program is original research in a great many specialized medical problems such as the limits of night vision, color discernment, hearing, the physiological effects of air pressures, psychological factors in submarine life, and the development of physical standards for personnel. Another major function of the laboratory is to pass judgment upon all men seeking admission to the submarine school.

"We try to judge the man as a whole," said Comdr. Gerald Dudley, laboratory chief.



Peck Practices a Resuscitation Learning Mass

A Japanese Freighter Torpedoed by U.S.S. *Guardfish*, Slides Beneath the Waves

[illegible]

After these physical examinations and interviews, we decide whether an applicant is wrong for the service, acceptable, or borderline. All borderline cases are referred to the commanding officer of the school for a final decision.

Because the high standards in this elite corps, rejections average only [illegible] percent. [illegible] of the screening [illegible] being sent to New London.

One of the laboratory's most interesting research projects involves the psychological effect of color [illegible] United States submarines. Traditionally the interior of a sub was painted in gray and white.

"Now we're trying to improve the interior of the submarines for the sake of a better [illegible]," said Lt. Comdr. Dean Farnsworth in charge of the color project (page 62).

In psychological terms gray and white in submarines is very bad. The men were always trying to do something about it. They would [illegible] [illegible] to be [illegible] [illegible]. This [illegible] a [illegible] [illegible]."

With the aid of [illegible] professional color specialists, the Navy has been experimenting with new [illegible] pastel [illegible] [illegible] nylon covers [illegible].

"Greens [illegible] the most [illegible]," Farnsworth added. "They [illegible] light [illegible] and oranges, but they don't like red colors."

A Secret Project in "Siberia"

[illegible] New London's winters.

[illegible]

-ster sub, the *Harder*, [illegible] still on the ways, receiving finishing touches to superstructure and hull. Here the machine-gun chatter of chipping hammers rose and fell in an overpowering din.

Elsewhere among the [illegible] and shops, in a [illegible] guarded [illegible] Siberia," engineers were building the atomi[illegible] Nautilus, [illegible].

[illegible] pounce to usher in a new era of naval warfare," said Comdr. Edward L. Beach, smart young skipper of the *Triggerfish*. "A number of submarines [illegible] and that includes me—foresee the day when all warships must be able to submerge, or court disaster."

Beach had prefaced his surprising statement by conceding that many would [illegible] it [illegible] surd, fantastic. But, said this former naval aide to General of the Army Omar N. Bradley, just such skepticism greeted those who prophesied the deadly role of aircraft and the great striking power of fleet carriers."

"An atomic sub," he added, "will ultimately [illegible] now, have been considered impossible for any kind of vessel except a speed[illegible]

Miniature Ships Sail a Make-believe Sea

Using New Lond[illegible] Attack [illegible], submariners [illegible] battle exercises which [illegible] of dispatched [illegible] two ship models, mounted on [illegible] propelled [illegible] the periscope (center [illegible]). The [illegible] controls hip movements

[illegible]ly, I believe the surface of the oceans will become a sort of no man's land, to which ships in wartime will resort only in an emergency, and where their danger will be great. In short, the submarine will inherit the seas."

Such a forecast sounds incredible today. Yet I talked to a surprising number of young officers who agree emphatically with Commander Beach.

Subs Fight Daily Battles

Marine engineers know that under certain [illegible] a submerged submarine encounters less resistance in moving through the water than does a surface craft, which is buffeted and retarded by both wind and wave. [illegible] possible some officers now believe, for nuclear-powered submarines [illegible] ely to out [illegible] surface vessels.

That day, if it comes, will be years hence. Beach and others stress [illegible]. It is far from just around the corner. Many complicated problems would have to be solved [illegible].

[illegible] years [illegible] our Silent Service and antisubmarine warfare units welded in a firm partnership. [illegible] development is one of the [illegible] with the highest priority, receiving [illegible] of all Navy research and development funds.

Blimps and airplanes can [illegible] a vast

* See "New Queen of the Seas!" Aircraft Carrier [illegible] Nov. [illegible]

expanse of ocean with our new radar sets, whose screens provide ten times as much coverage as the old World War II equipment. Large objects can be picked up at great distances. Within certain lesser areas, even as small an object as a snorkel head can be detected.

Radar, however, cannot penetrate the ocean depths. To find submerged submarines the Navy relies primarily upon sonar (sound navigation and ranging).

Tracking Down Undersea Raiders

Unlike radar and light waves, sound travels much better through water than through air. Most of us discover this fact as youngsters while learning to swim. Remember your annoyance when some friend knocked two stones together underwater while you had your head beneath the surface?

A sonar projector sends out supersonic waves, or "pings," which are reflected back from underwater objects. Receivers magnify the sound and measure the time lapse between ping and echo, thus determining ship-to-object distances.

Trained operators can tell whether the echo is from a submarine, a submerged rock, a school of fish, or other objects. If it proves to be a sub, electronic equipment will give range, bearing, speed, course, and depth.

Once a contact is made or suspected, planes and blimps may drop a pattern of sonobuoys. These expendable robots transmit sonar intelligence by radio. Aircraft also use Navy MAD equipment, magnetic direction finders which react to a submarine's metal hull.

Like radar, all these devices have certain range limitations. That's one reason why hunting down a submarine remains a large-scale undertaking and a matter of teamwork.

The research center for ASW techniques is Key West, our southernmost city, where the pace of naval activity is rapidly accelerating. Here are located a Fleet Sonar School, the Advanced Undersea Weapons School, and a number of air and surface units engaged in highly secret experimental work.*

Key West Keeps Pace with Subs

Installations built during World War II, such as the air center at near-by Boca Chica, now dwarf the fenced-in barracks and clapboard houses of the original naval station, site of President Truman's rambling Winter White House.

In the warm, pastel-green waters off Key West, students from the Sonar School fight hunter-killer mock battles such as I recently witnessed from the destroyer escort *Coolbaugh*.

As we put out into the Straits of Florida, a sister ship, the *Greenwood*, and the patrol craft *Mole* joined us astern. Somewhere ahead, cruising submerged, was the guppy submarine *Chopper*, our quarry.

Lt. Comdr. Clifton Southworth, a sonar instructor, sketched in the details of the day's plan. Our three-ship team would fire dummy hedgehogs—plastic-loaded projectiles stained with green dye to mark their point of entry into the water.

After each attack the *Chopper* would release an air bubble to indicate its position. If bubble and dye stain proved close, student's manning the detection gear could be credited with a hit.

We climbed below to inspect the sonar control room, an equipment-crammed cubicle deep in the bowels of the ship. Crewmen greeted me with a "welcome to Torpedo Junction!"

"I Am Attacking!"

Operators had begun "pinging" for a possible contact. An illuminated screen, marked like a compass, gave them a visual bearing on each object struck by the sound beam.

Three decks higher, we visited the underwater battery plot. Here sonar contacts were fed to an array of electronic calculating machines. A combat information center, located near by, kept a record plot of each contact.

Reaching the bridge, we found that the *Chopper* had been pin pointed and the chase was on.

Greenwood hoisted a flag, signalling "I am attacking!" Black smoke poured from her funnel as she turned abruptly and bore down on the target area.

A muffled report indicated the firing of a hedgehog. Seconds later a telltale dye ring appeared in the sea, but binoculars failed to detect an answering air bubble. *Mole* tried a similar run. The bubble, when it appeared, was some distance from the dye. Then it was the *Coolbaugh's* turn.

Water pulled from our bow as we moved in to attack. The hedgehog mechanism thundered: a projectile arched ahead and disappeared in the sea. This time a bubble burst to the surface within the green-stained circle (page 626).

Coolbaugh had scored a hit.

Attacks continued for more than two hours, until *Greenwood*, in tactical command of the day's operation, finally gave the signal to turn for home.

Commander Southworth had kept a box score on our ship's hits and misses. The

* See "From Indian Canoes to Submarines at Key West," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE, January, 1950.

U.S.S. *Nautilus*, the First Atomic Submarine, Will Grow from This Keel Plate

For atomic-powered submarines [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] took place June 14, 1952. [illegible] [illegible] River.

rockets had been successful in more than half of their attacks [illegible] [illegible].

Musicians Make Good Sonarmen

Both officers and enlisted personnel are trained at the Fleet Sonar School. Last year the school graduated nearly 3,000 men, more than during the peak years of World War II. Instructors find the best sonar students are natural musicians.

A sonar operator must be able to [illegible] [illegible] fractional notes, [illegible] Commander George Dawson, the school's executive officer. "As a target approaches, its echo increases in pitch; a lower pitch indicates the target is moving away."

Sonar recordings, played in classrooms, teach pitch discrimination among new students. Other recordings introduce them to some strange underwater sounds which they must learn to recognize instantly.

Listening to some of these noises, I heard the [illegible] whale [illegible] [illegible], [illegible] [illegible] a submarine hull gives off a [illegible] [illegible]. A school of [illegible], [illegible] [illegible] [illegible] [illegible], sizzled and crackled like bacon frying in a pan.

Navy officers are frankly and openly enthusiastic over the [illegible] [illegible] of two new ASW developments now in the testing stage.

One is the acoustic homing torpedo. This weapon has proved to be [illegible] accurate, adaptable to use by both the submarine and ASW forces. It can be [illegible] "homing" as [illegible].

The second development is a new use for sonar. Scientists have developed a compact listening device which helicopters can [illegible], lowering [illegible] the sea [illegible] underwater [illegible] [illegible].

New-type [illegible] can be heard from a considerable distance beyond the effective listening range of [illegible] vessel [illegible]. Helicopters and [illegible] will lessen

A Huge Nose Identifies K-1 as a Lethal New Killer Submarine

[illegible] keel up for one specialized job: to [illegible] [illegible] [illegible] Washington, D.C.

that [illegible]'s rudder [illegible] under water with these [illegible].

Navy men refer to the [illegible] as [illegible]. I witnessed [illegible] [illegible] Straits of Florida. Somewhere beneath us was [illegible].

While our [illegible] hovered, [illegible] blades [illegible] spray from the water, Lt. [illegible] G. [illegible] pressed a button which lowered [illegible] to vanish beneath the green waves.

A Good Day's Hunting

For several minutes McKee listened on his earphones. Then a grin broke over his face and he [illegible] he had located the [illegible]. The [illegible] was drawn back aboard [illegible] Lt. Comdr. John R. Thompson, [illegible]

[illegible] were made before we called it a day. McKee [illegible] he had recorded [illegible]

[illegible]

Eighty-three years ago [illegible] Jules Verne [illegible] *Twenty Thousand Leagues Under the Sea.* He wrote of [illegible] the *Nautilus*, which roamed the bottom of the sea exploring its wonders.

Captain Nemo, commander of the *Nautilus*, [illegible]

[illegible] their submarines [illegible] power of nations.

[illegible] people. Two world wars have shown that submarines, in the [illegible] can wreak terrific [illegible] freedom. Despite the [illegible] of [illegible] science [illegible] countermeasure [illegible]

This article and its accompanying [illegible] have been approved for publication by the Security Review Branch of the Department of Defense.

Pakistan, New Nation in an Old Land

Carved out of Ancient India, the World's Most Populous Moslem Country Celebrates Its First Five Busy Years

By Jean and Franc Shor

With Illustrations from Photographs by the Authors

BONFIRES blazed in the Khyber Pass, and fireworks stuttered the muggy stillness of the East Bengal jungles in August of 1952. Baluchistan desert tribesmen flourished lances in tent-pegging contests, piercing pegs in the ground as they rode horses at breakneck speed. Millworkers and shopkeepers danced in the streets of booming Karachi and Lahore. The new nation of Pakistan was celebrating its fifth birthday.

Pakistanis had reason to celebrate, for above the sounds of merrymaking rose the steady clatter of looms, the whir of thousands of new cotton spindles, the drone of light industry. Pakistan, which less than a decade ago was only a dream in the minds of a few determined men, had won a place as a stable and prosperous member of the British Commonwealth of Nations.

The 76 million citizens of this new state make it the most populous Moslem country and the world's seventh nation in number of inhabitants.

Religion Changed the Map of India

"We had to struggle for a nation of our own," a Pakistan Government official told us in Karachi. "We were widely criticized when we demanded separate countries for Hindus and Moslems. People insisted that the subcontinent was an economic and geographical unit, and that partition would mean disaster.

"But man does not live by geography alone. Europe, North America, and South America are also natural units. But in all those continents individual nations have existed, and have grown great.

"We were sure of our ground. The Moslems had ruled India for three hundred years before the British came. Under British rule we withdrew from governmental affairs. The Hindus came to the fore. They held nearly all civil-service posts, controlled banks and business houses, and had far more educated men and technicians. They would have controlled a united continent.

"Religion was the most important issue," he emphasized. "The basic differences between the Hindu faith and Islam make it difficult for our people to work together. They regard the cow as sacred, we eat it. We have no caste system. Mohammed Ali Jinnah, the Father of Pakistan, summed it up in a single sentence:

"'One hundred million people,' he said, 'are too many to be a minority!'"

Jinnah had his way, and became the first Governor General of Pakistan. He lived for only a little more than a year, however, and Prime Minister Liaquat Ali Khan, his successor as leader of the nation, was murdered by a fanatic in 1951.

"Go See for Yourselves"

The present Prime Minister, Khwaja Nazimuddin, smiled across the luncheon table when we told him we had come to report on Pakistan for the 2,000,000 members of the National Geographic Society.

"You will find a country of strange contrasts," he said. "You must remember that while we are a new nation, we are a very old land. You will see turbaned tribesmen driving new American cars through streets crowded with camel carts. Modern factories stand next to the stalls of native craftsmen. Bullocks turn water wheels in the shadow of huge hydroelectric projects.

"There are contrasts in our Government as well. Our central administration is based on Western models, and our new constitution will combine the practices of democracy with the historic tenets of Islam. Yet, in our tribal areas, people are still ruled by laws which were old when America was discovered.

"But you are travelers. Pakistan is not a set of facts and figures; it is the sum of its people. Go see for yourselves."

We accepted the Prime Minister's invitation. For five months we traveled through every section of Pakistan. We rode trains and elephants, trucks and camels, airplanes and jeeps, river steamers and dugout canoes. We lived and talked with the people of Pakistan, and found them friendly, proud of their progress, confident of their future.

The picture is not all bright. We found famine in the Sundarbans jungles of East Bengal, and saw food riots in Lahore. We saw the police fire on crowds of students in Dacca during a demonstration demanding that Bengali be made an official language, but in every case we found the Government taking prompt and effective action.

Karachi's Port Trust Building Administers the Overseas Commerce of a Thriving City

[illegible]

[illegible] is the city [illegible] [illegible] of the American Embassy at Karachi. "There are [illegible] but not enough to [illegible] [illegible]."

Building a Nation While Living in It

A Karachi newspaper [illegible] summed up the story of Pakistan in a single [illegible]:

"[illegible] where [illegible] [illegible] [illegible] [illegible] by ancient methods. Women carry mortar in baskets on their heads, and workmen shape bricks by hand. We need space so badly that someone moves into each room before it is completed.

[illegible] We are building a new country while we live in it."

Mohammed Ali, Pakistan's Minister of Finance, pointed out that for the [illegible] straight year the country had lived within its means despite heavy expenditures on armed forces and [illegible] [illegible] India.

In 1947, when the new nation was [illegible] found itself with [illegible] [illegible] assets. The first was the vast area of rich [illegible] land in the western Punjab; and the [illegible] [illegible] jute [illegible] of East Bengal (see pages [illegible]). The [illegible], perhaps the most [illegible], was [illegible] [illegible] people.

[illegible] survival of Pakistan in those first

Parading Pakistanis Celebrate the Birth of Their Five-year-old Nation

[illegible]

[illegible] the [illegible] was [illegible] with [illegible]

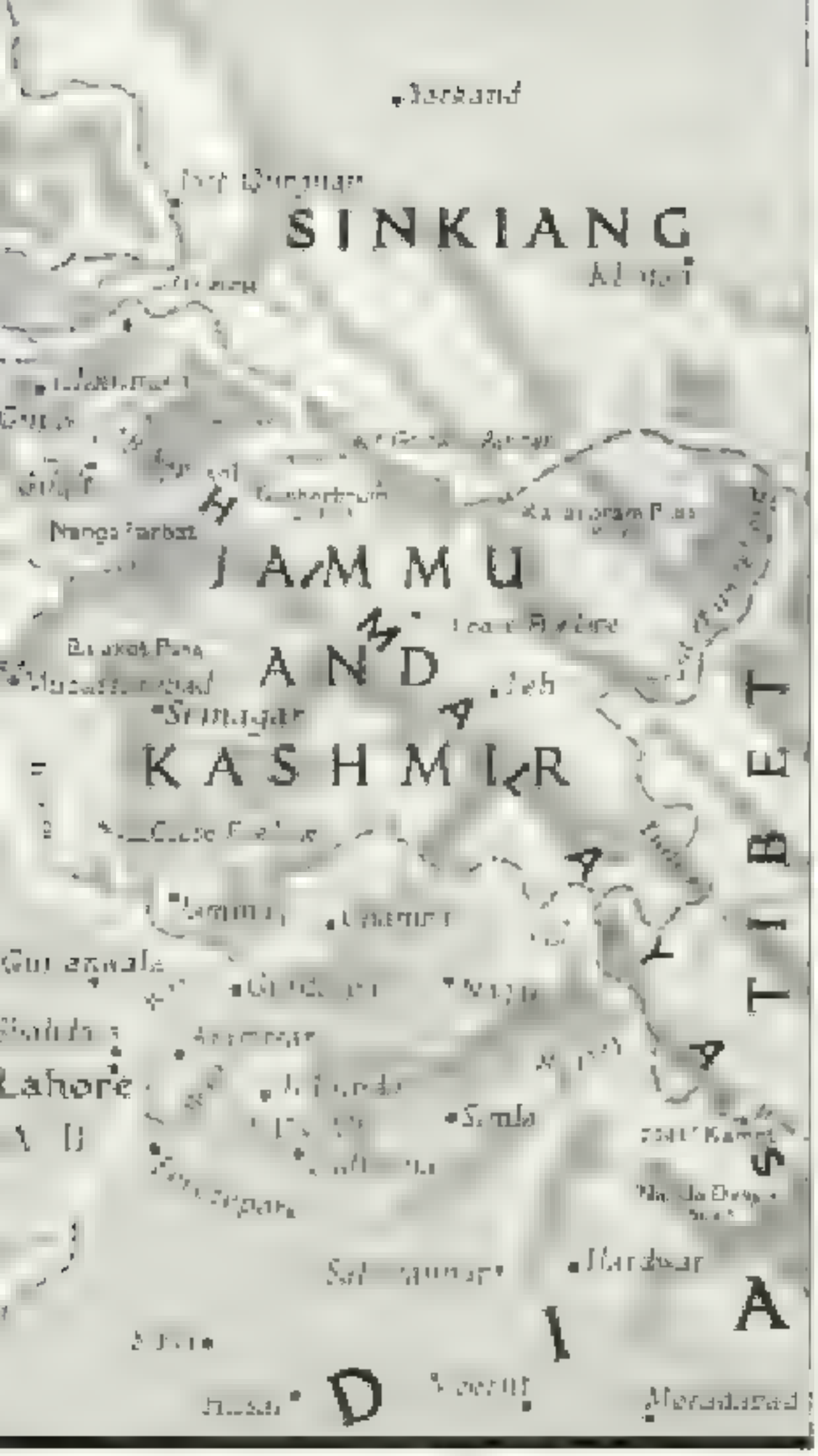
[illegible]

[illegible]

[illegible]

West and East Pakistan, 1,000 Miles Apart, Maintain Communications by Air and Sea

Eighty-six percent of the 76 million people are Moslems; 13 percent are caste Hindus and Untouchables



"The same thing happened throughout the country. That was the miracle of Pakistan, the miracle of the little man. He saved our nation."

Women Drop Veils, Rally to Help

Nor were the men alone in their answer to the call. For hundreds of years Moslem women have been secluded, sheltered from any contact with public life. But in those days of disaster, when refugees had to be fed and the sick and wounded cared for, the women of Pakistan laid aside their veils and came to the assistance of their nation.

"We called for them to come out and help, and they came by the thousands," said Begum Liaquat Ali Khan, widow of the Prime Minister. "The women of Pakistan learned in those hectic days, that they had a real part to play in the life of their country. They have never forgotten it."

Begum Liaquat helped organize the All-Pakistan Women's Association, and today that group of earnest Moslem ladies is one of the most progressive forces in Pakistan. It is devoted not only to removing the restrictions of purdah, under which some 20 percent of Pakistan's women still live in total seclusion, but to education, social reform, and giving women a place in Government.

"When you educate a woman, you educate the whole family," the Begum has said.

Many women have left purdah in the past three years. Women have won seats in provincial and national legislatures. A woman has presided over the sessions of Pakistan's National Assembly.

But the fight against purdah has widespread opposition. Pakistan's more orthodox Moslems are bitterly opposed to relaxation of the restrictions. Even two women who have been elected to one of the provincial legislatures sit in curtained enclosures and wear the burka, a heavy veil which covers them from head to toe. Only their eyes are visible, through tiny embroidered holes.

From Crowded Karachi to Desert Waste

In many ways the capital, Karachi, is typical of Pakistan. It is booming, changing every day, crowded with all the polyglot races of the country (page 658).

In five years the city has grown from 300,000 to 1,200,000 people. New buildings are going up by the hundreds (pages 646 and 651). In some cases, two or three families are crowded into a single small dwelling. The city is surrounded by acres of mud and straw huts in which unsettled refugees eke out a miserable existence.

Light and water facilities are strained to the breaking point. Bus conveyances are crowded. Streets are jammed (pages 646 and 662). Prices are high. The city is paying the price of the country's development.

From Karachi we traveled by train to Quetta, northward across Sind, and into the heart of Baluchistan Agency. This desert province occupies more than one-sixth of the total area of Pakistan, but its rocky wastes support fewer than a million people. Seen from our train window, the desert resembled the moon—stark sand and rocks, sheer, barren hills, ragged gulches.

But Quetta, set in a ring of rugged mountains at 5,500 feet, is crowded and colorful (page 649). It was almost completely destroyed in the great earthquake of 1935, which killed more than 24,000 people. The new buildings are one-story structures of adobe and concrete.

In late February we drove a hundred miles southeast to Sibi, winter capital of Baluchistan. The road was lined with migratory tribesmen. They winter near Sibi and in early spring move families and livestock 200 miles to summer pastures. Tents, blankets, furniture, and even chickens were piled atop the camels and donkeys.

Near Mach we stopped to chat with a

finally which had camped for the night. We had sleeping bags, and asked if we could stay with them, furnishing our own food.

"You are welcome to share our camp," said Latif Khan, "but you will also share our food. In the desert a traveler is a guest."

Our hosts were Brahui tribesmen (pages 652 and 653). Every man is armed, but they are friendly. Their ancient, muzzle-loading rifles have curving stocks inlaid with brass, and the hilts of their great curved swords are bright with semiprecious stones.

The women grind flour for each meal on flat stones. This they mix with water, baking flat chapatties on a stone over glowing camel dung. It is their only food on migration, and we insisted on adding to the supper.

We heated two tins of spaghetti and two of corned beef. The tribesmen ate the meal with their fingers. The spaghetti they found too slippery, so they drank it from bowls.

"Very good," said Latif Khan, "but very hard to catch!"

I began started to bury the empty cans. The tribesmen yelled an anguished protest, grabbed the cans and flattened them into sheets.

"Metal is more precious than food," explained Latif Khan.

In the morning our friends packed their beasts and started their sheep along the trail. Most of the women wore battered metal waterpots on their heads, like helmets.

"Imagine," said Jean, "going into a shop and saying: 'I'd like to try on a waterpot!'"

At Mach, on the railroad, camels carried coal from dozens of open-pit mines to huge piles on the rail siding.

"We have tripled coal production in this area in three years," the stationmaster told us. "Modern machinery has been ordered. But Pakistan needs coal desperately, and we are producing it by hand."

Tent with Twin Beds, Two Baths

At Sibi we were welcomed by Mian Amin-ud-Din, Agent of the Governor General, chief of civil administration in Baluchistan and the tribal states of Kalat, Makran, Las Bela, and Kharan. He had invited us to the annual Durbar Week, telling us we would be accommodated in a tent. We were, but the enormous canvas structure had twin beds, easy chairs, Oriental carpets, and two bathrooms where servants brought hot water at any hour.

At a dinner which featured three kinds of curry, each hotter than the last, the AGG told us of the modernization of Baluchistan.

"This is a food-deficit area," he said. "But it won't be for long. Work is under way on a $13,000,000 dam and irrigation project on the Bolan River which will bring 225,000 acres under cultivation."

Two smaller irrigation projects are also planned. Farmers have been taught improved farming methods, and better seeds and breeding stock are being furnished by the Government.

"A desert area doesn't have to be poor," said tall, Oxford-educated Amin-ud-Din.

Begum Amin-ud-Din, a gracious woman with a sparkling sense of humor, is a leader in the All-Pakistan Women's Association. Her job is difficult, for the tribesmen cling firmly to their traditional way of life.

"We move slowly," she told Jean, "but the movement is spreading. We have provided a market for the beautiful embroidery done by the women, and they are earning money. When a husband finds his wife adding to the family income, it has a fine effect on his attitude toward the responsible organization."

She showed us the famous embroidery done in Baluchistan. Tiny mirrors are embroidered onto the cloth. Some women, she told us, are too poor to buy scissors, so they bite the thin sheets of mirror to proper size.

"We furnish cloth for them to make costumes," she said. "They use the new material for the front, but the back is always of patched material. 'No one will look at a poor woman's back,' they insist, 'so why should we waste good cloth?'"

Durbar Like a County Fair

Durbar Week brought thousands of tribesmen to Sibi. The occasion was like a county fair at home, with races and judging of stock and exhibits.

On Durbar Day scores of khans, nawabs, chiefs, and subchiefs appeared to receive their annual grant. Border tribesmen are not subject to Pakistan laws, but are ruled by "Customary Laws," based on tribal practices. The chief of each tribe is responsible for the maintenance of law and order, and is rewarded with an annual cash payment.

Many tribal leaders wore the traditional formal dress of the desert—a long white shirt and baggy trousers containing many yards of

© National Geographic Society Kodachrome by Jean and Franc Shor

Beneath the Tasseled Turban Stands ➔ Six-feet-six of Pathan Guard

Pakistan assigns to its Governor General a personal bodyguard of 24 crack cavalrymen, who escort his state coach and stand watch outside his residence in Karachi (page 644).

Its elite guardsmen are carefully selected from Pakistan's regular military forces. Each must be at least six feet tall; one of them is seven feet. Uniforms are similar to those of the Bengal Lancers.

This mustached trooper, who sometimes stands guard in 120° heat, wears a 20-pound outfit, including wool uniform and high boots. Regulations permit the safety pin securing the peak of his turban.

Pennants Hang from Lances as the Governor General's Bodyguards Walk Their Horses in Review: Karachi

Bidadasar's Police Pipe Band, Playing in Sibi, Skirls Scottish Airs, a Heritage of British Occupation

Karachi's Traffic Is Complicated by 28 Types of Registered Transport, Including Pedicab, Cycle and Camel Cart

▼ A [illegible] ▼

Panted Balconies Brighten a Karachi Apartment Building

A Quetta Merchant Decorates His Bubble-bubble

[illegible]

Skins, Rugs, and Hats Drape a Peddler

[illegible]

• 1933 and New Brand in Country Circle Dress Rehabilitated Gasoline Carts

[illegible]

• Wooden Wheels Shriek as Cowards Haul Huge Loads of Cotton near Shahpur

[illegible]

Kalmyk Tent-Dwellers, Donkeys and Camels Migrate Twice a Year

[illegible]

Armies for Centuries Have Poured Through Khyber Pass, Gate to Central Asia

Jutting above Afghan Mountains [illegible] the Khyber Pass, the Moghul [illegible] the British [illegible] Hindu-Kush [illegible] Marching westward to the pass [illegible] Tamerlane [illegible] Alexander [illegible]

Two Roads Ahead: the Dotted, the Upper for Automobiles, the Lower for Pack Animals

[illegible]

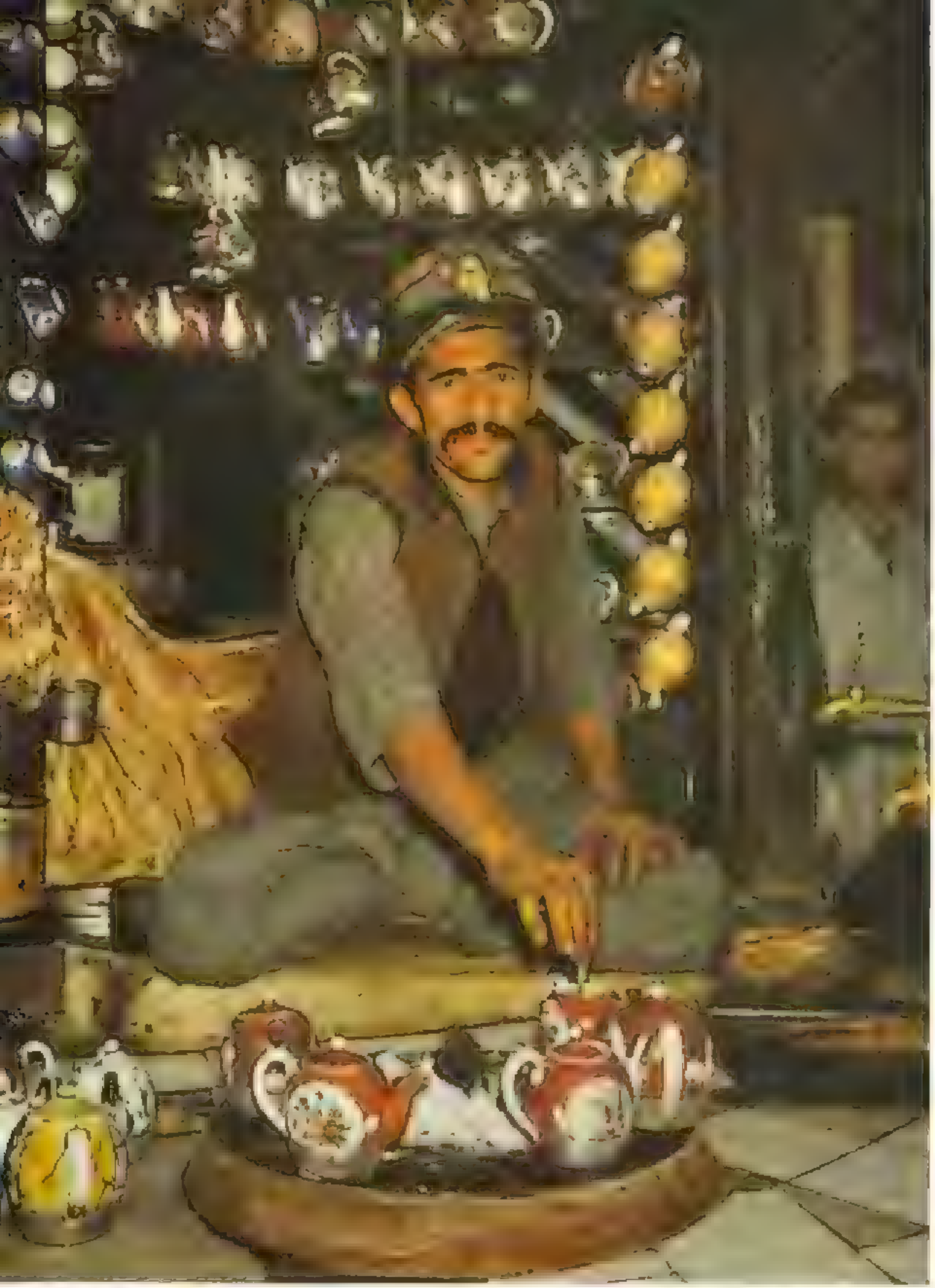
Badshahi Mosque's Dazzling Facade and White Domes Shine in Its Reflecting Pool

Loudly sacred is this edifice in Lahore. Aurangzeb, last of Islam's great Moguls, built it in 1674, next the great [illegible]

A Bearded Mullah's Oil Lamp Lights Up Jahangir's Tomb near Lahore

[illegible] impressive Pomes, [illegible] the fourth [illegible] the great Mo[illegible]

[illegible]



Tart, Hot, Strong and Sweet, Is Pasteur's Brew. This Shipbreaker Has the Pure for Ja

material. Nearly all had magnificent beards; some wore their side locks hanging to their waists in the ancient fashion.

There was a stir in the crowd, and Jean looked up from her camera.

"If we weren't way out here on the desert," she whispered, "I'd swear that woman who just came was Mrs. Roosevelt."

It was. She had arrived in Karachi the day before and flown up for a two-hour visit.

In the front row of the ranking chieftains sat two remarkably handsome young men, tall, with neatly groomed spade beards. Our host's son identified them as the Nabob of Marri and the Nabob of Bugti, leaders of two of the principal tribes. Later he introduced us.

Both spoke perfect English. The Nabob of Marri grinned at our astonishment and explained that he was a graduate of a Lahore college. I thought how fortunate it was that so well-educated a young man should be the leader of 65,000 primitive tribesmen. Surely his rule would be progressive.

Our talk turned to the problem of punjab. Jean asked if he was relaxing the restriction in his tribe.

"Certainly not," he snapped. "We hope to make it more strict."

Death for Talking to a Strange Man

While we stood in open-mouthed amazement, he explained that if a Marri girl over 10 years old is seen talking to any man other than her husband or a blood relative, both are killed instantly.

"Any male relative of the girl or her husband can put them to death on the spot," he said. "There is no penalty. It is his duty."

"But it must happen very rarely," I suggested.

"We have had half a dozen cases in the past two months," he said.

Among the Bugtis and Marris, as well as other Baluchi tribes, wives are still bought like cattle. A young man of marriageable age selects any girl of eight or ten, and bargains with her father. When the price is paid, he takes her for his bride. In some cases, a government official told us, a man who cannot pay is given the girl for nothing, agreeing that her first daughter will be returned to the grandfather for subsequent sale.

In many ways the Customary Laws of the primitive border tribes vary widely from civilized standards. Murder may still be punished by a fine of less than a hundred dollars. Blood feuds are recognized. However, the Government has declared its intention of bringing tribesmen under the Pakistan legal code.

We left by train for Lahore—and awoke in a different world. Our train had crossed Bahawalpur State during the night, and now we were running through the Punjab. Mohammed Ali Jinnah called this great plain, with its 62,000 square miles of rich agricultural land and its tall, hard-working and hard-fighting citizens, "the Heart of Pakistan." Our train ran through miles of rich grain and cotton fields. Factories and cotton mills rose above the industrial cities of Multan and Montgomery. Orange groves appeared.

Lahore, capital of the Punjab, we found to be the loveliest city of Pakistan. It is justly proud of its universities, libraries, and historic monuments (pages 656, 657, 674). But when we started to take a picture of the stately High Court building we were confronted by a soldier with fixed bayonet who ordered us to put away our cameras.

"Why?" we asked.

"Military security!" he snapped. Sadly we walked into the nearest bookstore and bought a post-card view of the building apparently taken when the world was a little more sane.

Thal Project Creates Farms from Desert

From the Punjab comes much of Pakistan's strength. Its grain feeds the nation, its cotton clothes it; and the Punjab are the ministry of its army. But the Thal Project is Pakistan's greatest pride.

Thal is a great expanse of sandy desert covering five million acres in the west central Punjab. The $100,000,000 development includes the Jinnah barrage, an enormous dam across the Indus River (page 663), two hydroelectric plants, and hundreds of miles of canals which will irrigate a million and a half acres.

The project was begun under British administration, but development was halted by the war. In the past three years 300 miles of canals have been completed, and 500,000 acres planted to crops.

American tractors were breaking out great blocks of sandy soil, and we saw an odd example of progress in reverse.

"Agriculture normally progresses from the bullock to the tractor," pointed out Col. M. A. Akmal, coordinator of the Thal Project. "Here it goes the other way.

"Tractors are the cheapest way to break out large blocks of new land, but it is then divided into 15 acre tracts and allocated to farmers who lost their homesteads after partition. They can't afford tractors, so they farm with bullocks."

More than 10,000 refugee families have already been settled in the Thal area. South of Mianwali we visited Hazrat Hussain, who fled with his family from the Indian Punjab in 1947. He received his homestead in 1950.

Palestinians, Who Long to Travel, Face the Karachi Mail to Lahore

Khyber Pass's Turbaned Tribal Leaders Entertain Mr. Shah at Tea in Landi Kotal

[illegible]

I have a little bank account of my own [illegible] milking at Jeep

[illegible]

[illegible] and I took [illegible]

Purdah Not for the Poor

"[illegible] Jean asse | Akmal as we [illegible] country wom[illegible] in the smaller villages aren't veiled? [illegible] side with their menfolk

"Why [illegible] Mu[illegible]

"Of [illegible] Mu[illegible] [illegible] Lahore [illegible]

[illegible]

[illegible]

[illegible] beautiful [illegible] swam proudly about a pool in the [illegible] We stayed to take a picture, but, as the last

Karachi's City Hall Surveys Pavements Afloat with Life

Irrigation Waters of Jinnah Barrage, Which Dams the Indus River near Mianwali, Turn the Punjab Desert into a Garden

guest departed, three coolies waded into the pool, tucked the protesting birds under their arms, and started off.

"What's this?" Jean asked our interpreter.

"[illegible]."

"The birds were rented by the hour for the party," he explained. "They're going back to their owner."

A train carried us 275 miles north and west, across the Chenab, the Jhelum, and the Indus, three of the five great rivers which rise in the Himalayas and water the Punjab.

Morning found us rolling through miles of blossoming fruit trees outside Peshawar, capital of the North-West Frontier Province. Peshawar's role in the British-Afghan wars has made it, and the near-by Khyber Pass, known to every American schoolboy.*

Peshawar's narrow, winding streets were crowded with a wild array of Afridi, Shinwari, and Pathan tribesmen. Tall men, bearded, with deep-set fiery eyes and hawk noses, they wore tall turbans, colorful robes, sheepskin vests, and shoes turned up at the toes.

Fiery Tribesmen Guard the Khyber

With Agha Faquir Shah, a government official, we drove to the historic Khyber. For 33 miles the road twisted crazily up through narrow, rocky gorges, where the marauding Afridi once ambushed travelers and challenged numerically superior British forces. We passed dozens of armed tribesmen.

"Almost every family among the 10,000 people in this area has a blood feud," Agha Shah explained. "They shoot an enemy on sight. Under the Customary Laws, the only punishment is a heavy fine."

Bronze plaques cut the granite cliffs, commemorating British and Indian Army regiments which fought here. The roadside is lined with concrete tank blocks, set up by the British after the Germans attacked Russia in 1941.

There was no sign of cultivation, and we asked Agha Shah how the tribesmen lived.

"For years," he said, "these tribesmen have been paid to keep the peace. Pakistan has continued the practice. It sounds like blackmail, but it goes much deeper than that.

"This land cannot produce crops. There is no water. So these tribesmen 'farm' the pass. For centuries their ancestors have collected toll from passing caravans. Those who did not pay were murdered and robbed. It is their land; we simply pay for the use of the roadway."

We gazed westward for many miles into Afghanistan, looking down the narrow valley through which has rolled the tide of history (pages 654-655). Today brightly colored trucks carry loads of pomegranates and cotton from Afghanistan through the narrow defile.

"It's peaceful country now," said Agha Shah. "Since Pakistan was established, the tribesmen have been quiet. We keep only a very small garrison—less than a tenth of the former force."

Not Savages but Friends

At Landi Kotal we were surprised to find a reception prepared. Agha Shah had telephoned ahead, and the tribal leaders had arranged a tea. We had crisp roast partridge instead of cakes. Then a tall, fierce-looking chieftain twirled his white mustaches and made a speech (page 661).

"Before Pakistan," he said, "we knew little of Americans. We are happy to meet your people. We feel your visit is proof that Americans are interested in us.

"We are told that your Magazine speaks to millions. Please tell them that while they may have heard that in the Khyber they would find savages, it is not true. They would find friends."

Mohammed Sadik Khan, a tribal chief, translated our thanks and walked with us to our car. "Only a few years ago," he said, "Americans were unknown here. But you are the second to visit us this week."

"Who was the other?" we asked.

"Mrs. Roosevelt," he answered.

Guns, but a Modern Hospital, Too

We drove south of Peshawar, over the sheer Kohat Pass, to the little city of Kohat. Along the road we visited the famous tribal gun factories. Here, with only hand tools, the tribesmen turn out 3,000 weapons a month, each an exact copy of a modern piece, complete to proof and arsenal marks. We watched prospective purchasers testing the rifles, which sell for about $10, and found them quite accurate.

"Are they really as good as the originals?" I asked our guide.

"Certainly," he said, "except that if you fire them too rapidly the barrels have a tendency to bend double!"

In Kohat we saw Ghulam Mohammed, the Governor General of Pakistan, dedicate a strikingly modern 100-bed hospital. With him we toured the clean, airy wards, and saw the well-equipped operating rooms and X-ray laboratory.

At a tea following the dedication, Jean chatted with Begum Zari Sarfaraz and Begum Mumtaz Jamal, members of the North-West Frontier Province legislature.

* See "South of Khyber Pass," by Maynard Owen Williams, National Geographic Magazine, April, 1949.

Raza Ghazan Ali, Pakistan's First Woman Industrialist, Gives an Order to a Foreman

[illegible]

[illegible] remarkable intelligence and well-[illegible] I asked if [illegible] and if [illegible] in public life [illegible] part of [illegible]

Perhaps, [illegible] Sartaj Aziz, [illegible] we must think of our [illegible] Women are coming to the fore.

Off to See the Wali of Swat

Back in Peshawar we met the Chief Secretary of the independent State of Swat and [illegible] conference with the High [illegible] Mingora.

[illegible] and central government [illegible] The Wali of Swat [illegible] Northern Areas [illegible] Swat.

It is difficult to [illegible] a [illegible] the Wali of Swat [illegible] Mingora [illegible] Swat, [illegible] Swat [illegible]

[illegible] people [illegible] Marlagh [illegible] the present Wali [illegible] Wali [illegible] a pro-[illegible]

[illegible] Swat [illegible] Swat's public [illegible]

Training begins early. Even the walls of the schools are painted, in English, with such slogans as "Honesty is the best policy," and "Virtue is its own reward."

For a week we toured the 400 miles of fine new roads which lead to every part of the 1,800 square miles of Swat. Driving there is a pleasure. Elsewhere in the East a driver must dodge crowds of pedestrians. In Swat people walk on the side of the road (page 668). A man caught jaywalking, we were told, is forced to run down the roadside at top speed until he drops from exhaustion.

"Soil Needs Sleep"

Ancient customs still exist in the valley. A modern irrigation system has increased crop production fivefold in 20 years, but in the eastern part of the state we found no irrigating canals.

"It is not good for soil or man to have outside assistance," a farmer explained. "Both become lazy."

"These people have another belief which compensates for that one," our guide told us. "They say that soil, like man, needs sleep. They let a field lie fallow every other year."

Every Swat village has a school, where attendance is compulsory for both boys and girls. We took a picture of one group, and a little boy came shyly up to Jean, pushed a bunch of pink and white wild flowers into her hands, stammered "Thank you, please," and dashed back into the crowd.

Swat is an archeologist's paradise. Dozens of unexcavated Buddhist ruins dot the valley. With the Wali's permission, we spent a day digging in an ancient stupa, or memorial mound, and found Buddhist carvings and small statues showing strong Grecian influence. Swat was once ruled by Grecian kings, and Barikot, a small fort which was besieged by Alexander the Great himself, still stands at the foot of the valley.

The father of the present Wali turned the administration of the state over to his son three years ago and retired to a life of religious contemplation.

"We have made improvements in agriculture," the young Wali told us. "Now we are developing light industries and processing plants. We are bringing in machinery for sugar mills, to give our people more cash income."

Farmer's Son Goes to Medical College

We stopped one evening to photograph the mud-and-tile home of Ali Yusef, a short, henna-bearded farmer. He insisted that we stay for supper. Over rice, chapatties, and fiery curried mutton, he told us how life had changed in Swat in 25 years.

"I had no education," he said. "As a boy, I never saw chapatties and rice on the same table. We eat well now, and all my children are educated. My oldest son is in medical college at Peshawar; the state is paying for his education. We have good hospitals. Taxes take only one-eighth of my crop—my father paid from one-third to a half. It has been wonderful."

At lunch the Wali discussed plans to develop Swat as a tourist resort.

"With magnificent scenery, good fishing and hunting, and a fine hotel," he said, "we should attract vacationers. Have you any suggestions?"

"Why not build a museum near the ancient ruins," I said. "Get a trained man to supervise excavation. You might even let tourists help dig. The finds would stock the museum."

"Good idea," he said, and spoke briefly to a secretary.

"I'd like to take your picture," I said. "Could you put on your state robes tomorrow morning?"

"Sorry," he laughed, "but I'm probably the only ruler on the subcontinent who doesn't own a costume. I'm too busy for fancy dress."

When we said goodbye to Ataullah the next day, he also asked if we had any suggestions for the state's tourist development.

"Only the idea for the museum," I said, thinking it had been forgotten.

"That's already been taken care of," he said. "Didn't you hear the Wali speaking to his secretary? He told him to start construction of the museum and arrange for a trained man to supervise excavations."

Old Red Fort—and Modern Bridge

The Government-operated bus soon carried us comfortably over excellent roads back into the Punjab. We crossed the Indus at Attock Fort, one of the most romantic fortresses in the world. Built nearly four hundred years ago by Akbar the Great, it protected the vast breadbasket of India.

Here, too, is a great railway and automobile bridge, another souvenir of British development.

Twenty miles outside Rawalpindi we passed a Government ordnance factory which sprawls for miles beside the highway. Millions of square feet are already under cover, and thousands of neat houses are rising for the workers.

"What a pity," a fellow passenger said, "that, when Pakistan needs civilian goods so badly, we are forced to spend more than half our budget on military preparations."

At nearby Wah one of the largest cement plants in Asia has just gone into production. In the shadow of its huge stacks we ate a

Jean Shoes: Shopping in Seoul, Buy a Pair of Gradamoreacres Shoes for $6

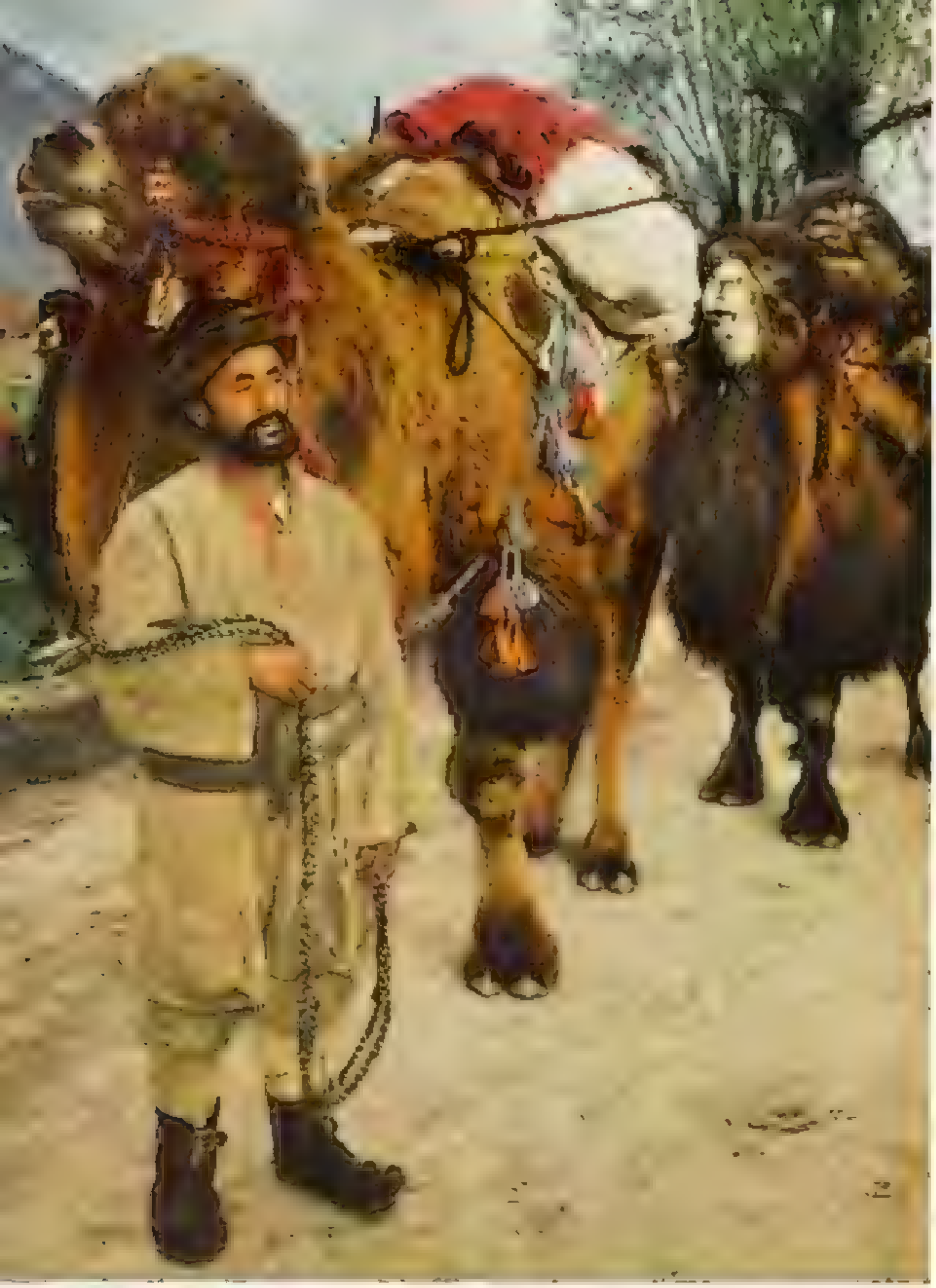
[illegible]

The Camera Catches Swat People Jaywalking in Kawazadela

[illegible]

Teacher Wags a Finger: His Pupils Recite in Unison. Their Education Is Free

Terraced Farms Stretch to Mountaintops, Eastern Arabia Irrigation Goes under Foot in [illegible]



Tacome Gaol-Bar Rebuts a Caravanner Leaves His Shoes Bactrian Camels Into Gobi.

[illegible]

The Pole Ball Is Thrown Into Gilgit Tribesmen Start a Bareknuckling Game

[illegible]

picnic lunch in a garden built by Jahangir.

Rawalpindi is headquarters of the Pakistan Army, the darling of a people who have always prided themselves on their fighting qualities. We dined with the Commander in Chief, Gen. Mohammed Ayub Khan, a giant of a man with fine mustaches, and Sir Douglas Gracey, first commander of the army and now an advisor to the general.

"Man for man," the general told us, "the Pakistani soldier is a match for any in the world. Our army is well-trained and well-equipped. It has great spirit. It is ready for any eventuality."

Sir Douglas, soon to retire from his advisory duties, told us he plans to stay in Pakistan and go into business.

"There is no limit to the opportunities to be found in this country," he said.

A government information official arranged for us to visit Azad (Free) Kashmir, on the Pakistan side of the cease-fire line. The dispute with India over the State of Jammu and Kashmir is, of course, the most important problem in Pakistan today.*

With a madman for a driver, we raced over 70 miles of tortuous mountain roads to Muzaffarabad, capital of Azad Kashmir. Our driver turned off the engine and coasted down miles of cliffside road at breakneck speed. "Gasoline very dear," he explained.

"Neck also very dear," said Jean. "Turn on that engine and go slowly!"

He did, but with a look of contempt.

Some of the most remarkable terraces in the world cling to the sides of Azad Kashmir's rugged mountains. Wherever there is a little soil, rock walls support tiny fields. Despite its mountainous terrain, the area produces a food surplus.

Piano Goes by Air

In every village we saw schools. Some were in whitewashed mud huts, others simply little groups of teachers and students on rocky hillsides (pages 673-674). Pakistan's promise of education for all is being fulfilled.

From Rawalpindi we flew 180 miles northeast to Gilgit on one of the most thrilling and dangerous air lines in the world. Until a few years ago, only pack trains linked the little district of Gilgit with the rest of the country. The trail was open only a few months a year, and it took twenty days for horses to make the perilous trip. Now three war-weary American-made C-47 aircraft make as many as ten sorties a day.

"We carry food, medicine, gasoline, cloth and a hundred other things to these isolated people," one of the pilots told us. "We even flew in a piano for one of the hill rajahs. Coming out, we bring hides and sheepskins and dried fruits."

There are no weather stations in the area and no directional radio beam. The planes have a service ceiling of 15,000 feet, but such peaks as Nanga Parbat and Rakaposhi rise more than 25,000 feet along the way. The pilots fly by sight—and sometimes the weather closes in so rapidly they must fly blind through the narrow passes.

Polo in the Gods's Cradle

Pakistan maintains a political agent at Gilgit to watch over the affairs of the native states. Syed Faridullah, a buoyant, jovial Pathan, met us at the mountain-fringed airfield and whisked us by jeep to a polo game which had been arranged in our honor.

"This isn't polo like the Americans play at Meadowbrook on Long Island," he said, "but it's more authentic. These mountains are the cradle of the modern game. It's the hill tribes' favorite sport; every little mountain village has its own team."

The game was the most thrilling we have ever seen. There are no fouls, no rest periods, and no changes of ponies (page 673).

After this rough game it seemed appropriate to visit the Gilgit hospital, where two Pakistani doctors bring modern medical service to the hill people. As we left, Faridullah pointed to the rickety wood cart which serves the hospital kitchen.

"The members of your Society helped buy that," he said. "The wheels are from the 'silver Crescent' which was left here by the Citroën-Haardt expedition."†

Syed Faridullah took us by jeep over 20 miles of rocky road to a great canyon, where thousand-foot rock walls rise sheer above a tumbling river. As we halted, a blast rocked the jeep, and a shower of rocks flew from a corner of the canyon.

"A new irrigation canal," said the political agent proudly. "There are hundreds of acres of fertile land in the valley which need only water. This job was too difficult for primitive methods, and the people were too poor to

© Kodachrome by Volkmar Wentzel

Pakistani Girls Studying To Be Doctors Illustrate a Peaceful Revolution

Ten years ago no proper Moslem girl would have gone to public school. The thought of nurses in [illegible] professions would [illegible]. Today, responding to the needs of their country, some 100 daughters of Pakistan's best families attend Fatima Jinnah Medical College for Women in Lahore.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "New National Geographic Map Shows Changes in Asia and Europe," March, 1951; and "The Lovely Vale of Kashmir," by Volkmar Wentzel, April, 1946.

† See "First Over the Roof of the World by Air," by Maynard Owen Williams, NATIONAL GEOGRAPHIC MAGAZINE, March, 1942.

Roosevelt Does Its Daily Stamping in Rajah Bazaar

Commerce Is Booming in Kuwait Harbor—Ships, Dhows, and Cranes Cover Five Miles of Piers

afford dynamite and modern equipment. We are furnishing those and they furnish the labor. In a year we'll have added 15 percent to our food supply."

We climbed back into our plane with 14 teen-age Gilgit boys.

"They've just graduated from our local school," Syed Farzullah explained. "They're going to Peshawar to take the Cambridge secondary examinations. Those who pass will be sent out for advanced schooling."

Rough Ride to Rawalpindi

Gilgit very nearly lost a large percentage of its educated population on that flight. The wind shifted just before our take-off, and our pilot, a bearded Pole who had flown with the RAF during the war, hesitated for a moment, then swung the plane around.

Instead of taking off across the flat bed of the Hunza River, we faced up the field toward town, barely cleared the low trees, stood on one wing tip as we banked against the walls of a dead-end canyon, and wobbled out over the grain fields at the edge of town.

"I've always wondered if I could get off in that direction," laughed the pilot, who had invited us to share the cockpit.

His smile didn't last long. The shifting wind brought sudden clouds, and within 30 minutes we were flying blind. We radioed Gilgit that we were returning. "Don't come back," came their reply. "Field closed in."

"Go back and make sure those kids are strapped in," the now grim pilot told me. "We'll have to go down and try to follow the Indus and it'll be rough."

It was. As we twisted through a narrow gorge, trees whipped past only a few feet from our wing tips. Suddenly the plane seemed to stand on its tail, the engines labored as if in their death throes, and the frame shuddered as we climbed steeply to avoid an unexpected cliff.

The students never lost courage. Half a dozen were very airsick, but I never saw a look of fear on a single face. I doubt if they could say as much for me.

An hour out of Gilgit the pilot checked his maps and shook his head. "Don't dare stay down here any longer," he said. "The gorge gets too narrow. We'll have to go up into that soup. I think we can clear the pass. If I've figured right, we'll go over at 12,000 feet. If I haven't—well, here we go."

He put the plane into a steep climb and the clouds closed around us. The windows were patches of murky white. The engines droned a deeper song.

For 15 minutes we flew blindly ahead and up—always up. Then the clouds seemed to thin out. In a moment we were in the clear. Two hundred feet below, the jagged peaks of the Babakot Pass seemed to reach up for the fragile skin of our little plane.

"As I told you," laughed the pilot, wiping his forehead, "never a dull moment. We'll be in Pindi in half an hour."

We were. Never have I enjoyed a walk so much as I did that 100-yard trip from plane to airport.

We had planned to fly back to Karachi. Somehow, however, we felt that we had seen enough of airplanes for the moment.

On the Karachi Mail we rattled south for two days, down the 900-mile length of the country. The roadbed was rough, the coach swayed and jolted, and it was so hot we kept a 200-pound block of ice in the compartment and let the fans blow over it day and night. But we didn't complain.

"A little rough," said Jean, "but it's so nice to know there won't be any unexpected mountains on the track."

Briton Says Pakistanis Learn Fast

We shared our compartment with a British businessman, an importer of heavy machinery.

"I've been out here for 25 years," he said. "When Britain gave up India, I thought I was through. Then a Pakistan official, a man I'd known for 20 years, came to see me.

"'Don't leave,' he said. 'We need you. We have an enormous amount of building to do, and we need your know-how and the experience of the technicians on your staff. We can work together, and we'll all profit.'

"He was right. Last year was the best in the history of my business.

"We are training Pakistanis in a lot of jobs for which we used to bring in foreigners. They're learning fast. They're eager, and they are willing to work hard. That's half the battle, any place in the world."

We left Karachi feeling that we had witnessed a great adventure in western Pakistan—the development of a new nation. (The eastern part of this remarkable country—divided physically but united in spirit—requires another article.)

As the Prime Minister had told us, this is a new nation in a very old land. And the hard-working Pakistanis, proud of their history and confident of their future, are turning that old land into a modern, prosperous nation where more people can lead better lives than they have ever known before.

A Shark Walker Revives a Captive in Florida's Marine Studios

Grabbing a fin and shoving the diver restores vital air to an exhausted shark caught at sea and transferred to the 165 rectangular aquarium in Marineland, Florida. Fresh sea water flowing across gills gets oxygen back into the blood stream (page 644).

Marineland, Florida's Giant Fish Bowl

By Gilbert Grosvenor La Gorce

With Illustrations by Luis Marden, National Geographic Staff

Pig-nosed Spotted Whip Ray, Flapping Its Batlike Wings, Appears to Fly Through Water

[illegible]

MAN has always been fascinated by the sea [illegible] strange forms. But not until [illegible] has it been possible to view a few inches from [illegible] predatory [illegible]. The [illegible] and water live together in surroundings like those of their natural habitat.

Today at Marineland, between St. Augustine and Daytona Beach, Florida, [illegible] "oceanaria" [illegible] together in two huge tanks connected by a flume. The tanks [illegible] port holes [illegible] and beneath these great [illegible] the [illegible].

In the [illegible] water [illegible] silver [illegible] [illegible] also [illegible] of the [illegible].

Here too are bottlenose dolphins, or porpoises, as they are commonly called. Known and loved by mariners [illegible] into captivity here at Marine Studios. Photographer [illegible] and I [illegible].

At [illegible] below the surface we [illegible] along the [illegible] corridors that [illegible] the big tanks. Through specially [illegible] glass ports we gazed into a [illegible] world of sunlight and shadows. [illegible] tropical fish [illegible].

If the Ray Looked Out of His Tank, He'd See These Girls Looking In

Marineland's [illegible] tank [illegible] [illegible] [illegible] [illegible] [illegible]

Suddenly, out of the haze beyond the wreck, appeared the Martian face of a [illegible] ray. [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] fish. Now in a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] inches [illegible] the [illegible] [illegible] of the steps [illegible] [illegible] to the [illegible].

Divers Hand-feed Some Fish

The [illegible] viewers watched the shadows [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the diver stepped back, holding his wire basket filled with chopped mullet [illegible] [illegible] [illegible] ward off a possible attack.

We watched electrified. Man and ray eyed each other for a few seconds. Then the monster [illegible] his powerful tail and disappeared into the central gloom of the tank leaving a swirl of bubbles in his wake.

Several times a day a staff diver must make the rounds of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the other visitors [illegible].

"Look there!" [illegible] [illegible] "At the base of the [illegible] [illegible] [illegible] [illegible]

The thick-bodied, sharp-toothed [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

"[illegible] [illegible] [illegible]?" asked some one in the crowd.

It was. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] vegetarians. [illegible] [illegible] [illegible] [illegible] [illegible] tank [illegible] [illegible] [illegible] [illegible] gaze.

In the tank the spectators [illegible] an ever-changing pattern of fish [illegible] [illegible]

Flippy the Porpoise Is Always Happy to Oblige Friends or Please a Crowd

[illegible] favorite [illegible] tasks and h[illegible] [illegible] the first [illegible] Flippy [illegible] porpoise to [illegible] (pages [illegible])

[illegible] and [illegible] others [illegible] followed [illegible] [illegible] purse [illegible] the [illegible]. We tried to spot others as the announcer called them out.

"Those are angelfish . . . Here comes a parrotfish, with sheepshead just below it . . . These are triggerfish, with a school of young [illegible] next in line."

Near the water's surface [illegible] of [illegible] shrimp snapped backward [illegible] [illegible] they [illegible] [illegible].

"We [illegible] the makings of an orchestra," the guide said with a smile. "Here you'll [illegible] a guitar fish, a cornet fish, a bass fish, and a drum fish."

Porpoises Are the Star Performers

But by far the most popular with the public are the porpoises. Porpoise feeding time at Marineland is a major performance. In addition to learning to accept food from an attendant's hand in the water, the creatures learn to leap [illegible] into the air to take [illegible] from the [illegible] hand (pages [illegible]).

[illegible] 22 species of [illegible] in [illegible] waters, the most common in this country being the gray bottle-nose dolphin (the inshore porpoise), *Tursiops truncatus*. In the [illegible]-diameter circular tank are also specimens of the deep-sea, long-snouted dolphin [illegible] "spotted" porpoise, *Stenella plagiodon*.

It takes [illegible]

Porpoise, Mammal That She Is, Gives Birth to Fully Developed Young

[illegible] Marineland. The mother, anxious to [illegible] with a quick [illegible] [illegible]

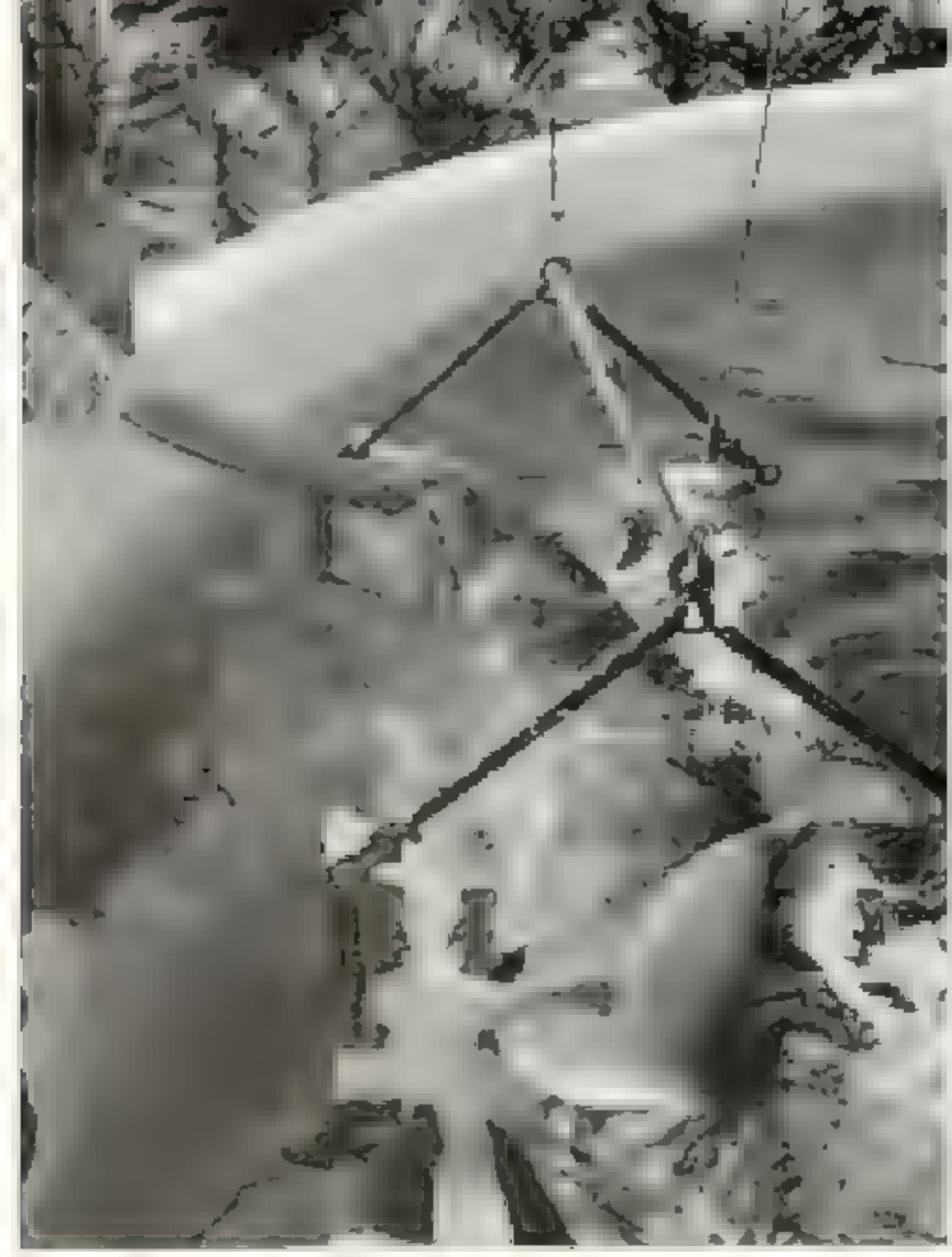
[illegible] artist explained. "It will then begin to accept food from the attendant's hand."

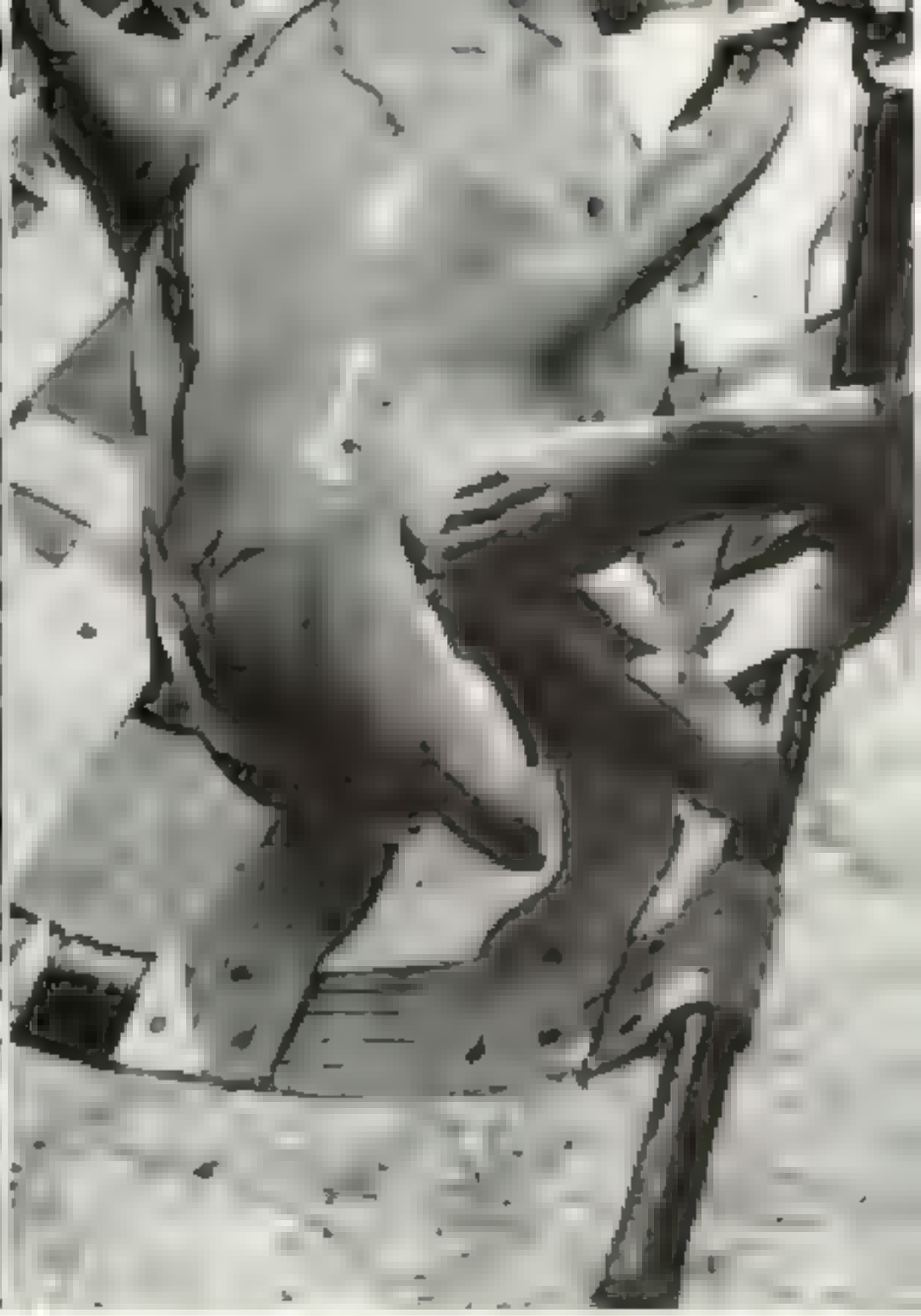
The intimate [illegible] bathing in channels between points of land, where the animals feed in tidewaters. The [illegible] the place, its body kept dampened to prevent [illegible] the proper body temperature while out of its natural element.

[illegible] ant continued, "none has ever attempted to [illegible] attack the collecting crew."

[illegible] are captured with a snare. Only a few miles at sea, the collecting crew sets one of the powerful [illegible] porpoise [illegible] the collector to thrust the mechanical lasso with its [illegible] porpoise's body just above the tail. A hemp line [illegible] and [illegible] porpoise tows the boat over the ocean. Usually wearying in less than half an hour, it is finally drawn alongside

Flippy Yanks a Lanyard and Raises a Pennant





Flippy Cheerfully Leaves the Water for Weighing, Measuring, and Doctoring

[illegible] boat required [illegible] for his [illegible]

[illegible] their oxygen supply normally at least once every forty seconds, although they can stay under water up to seven minutes. Usually they rise to the surface at such intervals, clear the blowhole on top of the head, and expel [illegible]

Porpoises are natural clowns. They love to [illegible] other creatures in the aquarium. Frequently they nip at the tails of little fish that hide in the [illegible]. Occasionally they will devour one whole, for porpoises feed only on species of fish they can swallow without chewing. Their teeth are capable of inflicting damage, but they reserve these tactics for [illegible]

Porpoises Ram Sharks to Death

When [illegible], porpoises become tough adversaries, ramming the sides of [illegible] with their powerful [illegible]. They are [illegible] [illegible] and [illegible] creatures [illegible] and respiration.

Porpoises in the aquarium have weighed more than [illegible] pounds. [illegible]

In this tank the Studios staff has witnessed the birth of [illegible] (page 683). The mother porpoise [illegible] about 12 months before the [illegible] to eat fish.

But even new babies [illegible] with the others. The mother [illegible] by a friend [illegible] her [illegible] with her body to protect it from possible attack by [illegible] that might [illegible] purposes.

[illegible] ability to learn has been recorded at [illegible] biological laboratories. [illegible] past two [illegible] experiments have been conducted [illegible] determine the extent to which [illegible] could be trained.

Mr. Joseph Frohn, an experienced animal trainer, undertook the task at the direction of Mr. W. Douglas [illegible], president of Marine Studios, who [illegible] a trustee of the American Museum of Natural History, New York. Mr. [illegible] and [illegible] were [illegible] of Washington, [illegible] to pass.

"I [illegible] Mr. [illegible] Flippy [illegible] the [illegible] and the vice president and general manager of the studios, William [illegible] Robinson. "We are rather proud of this [illegible]."

The training was done in [illegible] Later, in an enclosed lagoon, the porpoise

learned to tow a surfboard while a girl and a dog rode as passengers (page 682).

We met Mr. Frohn, a friendly, keen-eyed man, whose sure approach to his job and masterful handling of his pet prove his years of experience in animal training. One immediately sensed the bond of friendship between the trainer and his charge.

"Flippy!" Mr. Frohn called. The young fellow, weighing about 200 pounds, had spotted us as we approached his tank. He thrust his head out of the water and swam to his trainer's outstretched hand. After eating him for a moment, the trainer tossed him a morsel of fish.

"I use the feeding incentive system," he told us. "It seems to work well with all animals."

After each trick, Flippy gratefully and delicately accepted the proffered fish titbit. We could plainly hear him whistling through his blowhole as he cavorted around.

Flippy Gives a Command Performance

"Watch how he blows this bulb horn and then ceases at my command," Mr. Frohn remarked.

Seemingly pleased at this particular trick, Flippy dutifully stopped biting it at the proper moment. He resumed his honking only when ordered.

"He would wear it out if I let him keep it up," the trainer said with a laugh.

In addition to leaping up and pulling a cord that ran up a pennant on a jackstaff, the porpoise gracefully jumped through a three-foot hoop suspended above the water (page 688). Then he performed the same act after the hoop had been covered with paper (page 684). As his head burst through, Flippy actually seemed to grin, as if approving our own pleased expressions and comments.

When not under command, Flippy watches his trainer constantly, head partly out of water, eyes and ears at attention. When we stepped back from the tank, Flippy popped up over the edge, resting his jaw on the rim while he surveyed Mr. Frohn solemnly.

"He looks as if he wants to climb right into your arms," I remarked.

"One time he did," replied our host. "I was working out of a skiff in the lagoon. As I offered a morsel of fish, Flippy, in his exuberance, jumped clear of the water into my arms. He is only about four and a half years old, but he's some baby to hold!"

Flippy then went through his repertoire: rolling over and over at the command; surging out of the water to grasp a rope and ring a bell; retrieving a thrown stick; backing up, head out of water, at each successive wave of his trainer's hand; and then expertly catching a thrown rubber ball, which he promptly returned to his master.

One trick was a supreme show of confidence and trust on the part of the animal. Mr. Frohn suspended a canvas sling over the tank, then lowered it beneath the surface. At his command, Flippy swam obediently onto the sling and lay there motionless. Mr. Frohn then hoisted the sling clear of the water. The porpoise remained absolutely still, except for the intermittent opening and closing of the blowhole atop his head.

A Porpoise Can Get a Sunburn

"I don't keep him out too long in the sun. Porpoise skin sunburns quickly," the trainer said (page 685). "He got a bad case of sunburn on his head during the surfboard training period. I rubbed petroleum jelly on it to soothe the burn. My little dog watched the process with interest. Then when Flippy thrust his head out of water near our boat in the lagoon, the terrier would try to lick off the jelly. Flippy seemed to enjoy it, for he repeated the ritual frequently.

We learned that the Studios are planning to introduce a young female to this training program. Might she and Flippy produce a race of particularly talented porpoises?

"Who knows?" replied Mr. Frohn. "We might discover that Flippy is actually a rather dumb specimen." He added quickly, "But he's a lovable one."

Flippy's enthusiastic public acceptance has prompted an expansion program. Plans for next year call for construction of a "porpoise stadium" seating 1,000 visitors. This will surround an exhibit pool, 100 by 30 feet, where future aquatic stars can perform daily. Four connecting tanks will serve as training pools for Flippy & Company. More than 100 new portholes will be added to the oceanarium walls.

The Studios' expanding exhibits provide a visual educational opportunity for thousands of visitors annually touring Florida. Marineland presents a never-ending drama of the daily underwater life of colorful fishes and animals of the mighty Gulf Stream.

This Diver Caters to 10,000 Fish; Guests Gather for a Free Meal →

Marineland divers spend working hours prowling about two underwater wonderlands feeding and inspecting their voracious charges. Here a green moray eel, attracted by the tinted gear of Albert W. Taylor, Jr., emerges from his coral-rock home and hungrily [illegible] a lookdown (upper left), Bermuda chub (upper right), and two angelfish (lower left).

© 1956 Cousteau Society
Photographs by Luis Marden, National Geographic Staff

Flippy Spears the Hoop at His Trainer's Command

[illegible]

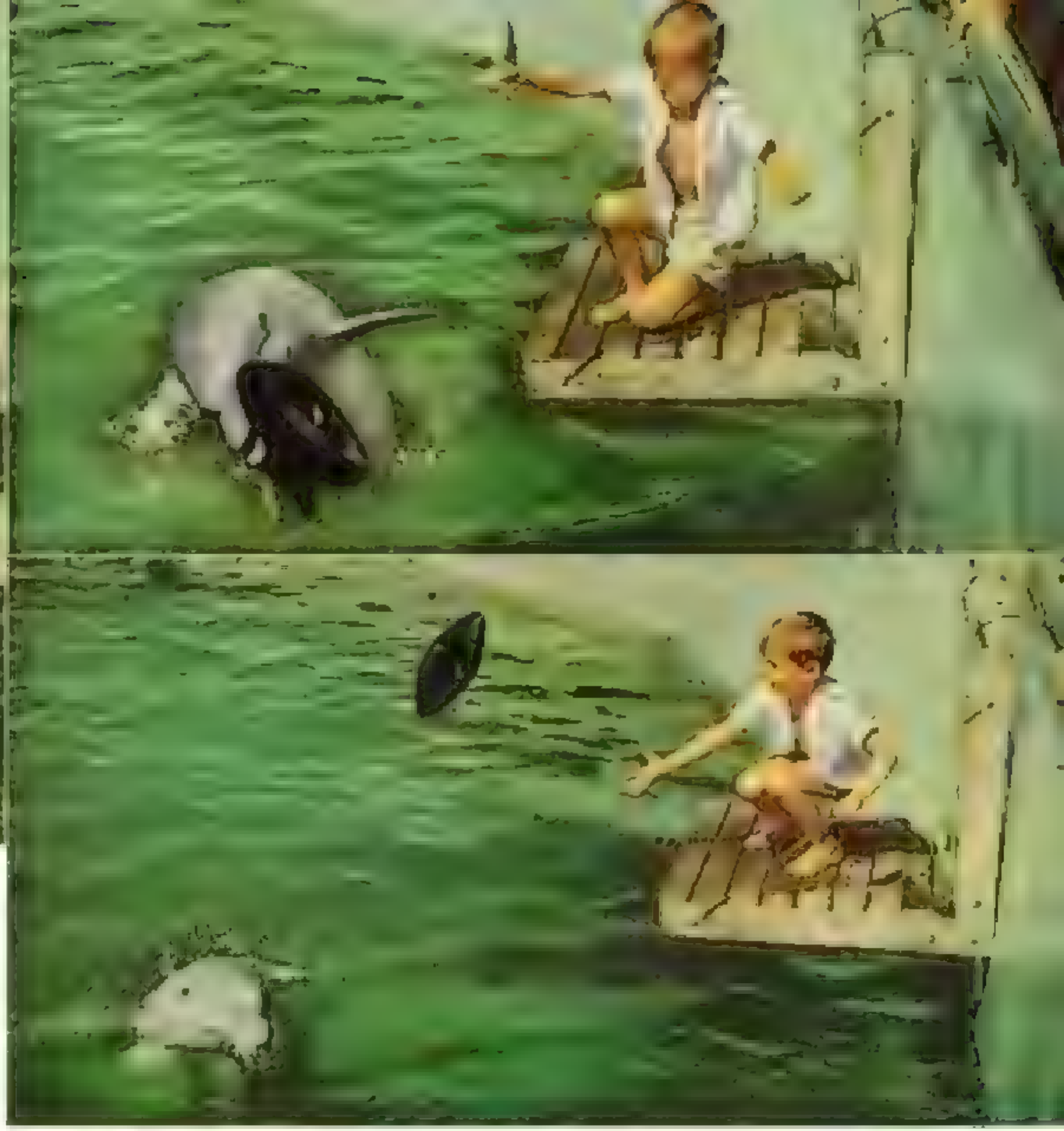
[illegible]

A Porpoise Leaps for Fish as a Trout Rises to a Fly

Porpoises Crowd the Pitcher's Box in a Ball Game Played with Mullet

Fielders Show Flashing Speed Retrieving Fish Tossed to the Diamond

When the Ring Is Tossed, the Young Dolphin Catches It and Hurls It Back



Sad Looks Reflect the Diver's Empty Feeding Basket

[illegible]

A Newly Caught Shark Gets a Stretcher Ride

Florida's warm seas [illegible] an apparently inexhaustible supply of marine life, but [illegible] Marineland [illegible] [illegible] [illegible] a [illegible] [illegible].

[illegible]

[illegible] the [illegible] for [illegible] is cut below the waterline. Specimens are maneuvered into the live well without [illegible] their natural element.

◄ This fish out of water [illegible] lies quietly because he [illegible] failure of oxygen. He [illegible] [illegible] [illegible].

▼ Shark walking [illegible] of Marineland [illegible] [illegible]. Using this form of artificial respiration, diver Floyd Adams [illegible] two tiger sharks. This [illegible] require as much as two hours.

[illegible]

[illegible]

The Jungle Was My Home

To a Lone Adventurer Hunting Jaguars with a Spear, the Years Bring a North American Wife and a Jungle-reared Family

By Sasha Siemel

With Illustrations from Photographs by the Author

FOR 32 years I lived in the jungle of the Mato Grosso, or Great Woods, of Brazil. My purpose: adventure. My occupation: chiefly hunting man-eating cats with spear and bow and arrow.

I have heard my jungle called a "green hell." I found it neither a green hell nor a green heaven, but simply home; an odd home, perhaps, yet the only one I knew from my twenty-fourth year, and more friendly than most.

Now I live, for a part of each year, on a small farm near Philadelphia. There are animal noises to wake me in the morning and to rouse me at night, but I find that I am waiting for others: the bawling of alligators on the riverbank, the chatter of monkeys in the trees, the throaty love call of a jungle cat, the shrill scream of a macaw.

Friends have said, "But at least you are less lonely now." I was never lonely in the jungle. I have been far lonelier in a city. In the jungle, even most animals are friendly, if you know how to behave toward them.

Did I miss the refinements of life? Well, it is true that until my wife joined me in the jungle with her sewing machine, my clothes often lacked repairs. But I survived.

After she came, things became positively civilized. Our children played tiddlywinks like any other kids. Of course the chips were alligator (caiman) teeth, but the game was much the same.

And we had a piano. It suffered somewhat from the jungle's dampness, but it remained adequate for Sunday-morning singing and for "Holy Night" on Christmas—with the temperature more than 100° F. outside!

On a Winding Road to a Jungle Life

No, I cannot say I ever missed what city folk call civilization. I left it willingly on a cold, wet day in November, 1914, and, if I had to relive my life, I would trudge again today that winding road up from Porto Alegre, in the southern tip of Brazil, to Passo Fundo and the rocky plateau of the Mato Grosso, a thousand miles inland (map, page 696).

When I first traveled that road as a youth it comprised little more than two wheel ruts cut in the reddish-brown soil by countless oxcarts carrying supplies to settlements and lonely ranches in the interior. Under dripping skies, with only a few hummocks tufted with grass to break the cheerless monotony of the countryside, I journeyed toward the jungle.

I had just come north from Buenos Aires by tramp steamer, landing at Porto Alegre the night before. I had not expected the cold rain. For some reason, I had not realized that Brazil, which stretches from 5° north latitude to 33° south, a distance of nearly 3,000 miles, can offer the traveler anything from the blazing heat of the Equator to the chilly winters of the lower Temperate Zones.

My immediate destination was a small farm owned by a German family I did not know. It was not until several months later, when I reached Passo Fundo and found my brother, Ernst Siemel—who had been in the Mato Grosso—that I decided to go with him into that remote interior, one of the wildest regions on earth.

Drawn by the Lure of Diamonds

The lure that drew my brother and me there was one of the oldest known to man: hidden treasure. Brazil's rock-crusted highlands are one of the world's great repositories of diamonds, both gem and industrial stones.

To the average person, the Brazilian diamond is not so well known as its African or Indian counterpart, although diamonds were found in Brazil a century before the diggings at Kimberley and Bultfontein in Africa. Generally, the diamonds are not large, and they vary in color from pure white to pale gold, green, blue, and smoky. Many have a yellowish tinge, which has given them a reputation for cheapness. But a pure-color Brazilian gem diamond ranks carat for carat with the best stones found elsewhere.

The area where diamonds are found, the southwestern part of the Mato Grosso, is, to say the least, not easily accessible. On the west it is guarded by the towering Andes and on the east by truly rugged jungle. Only the most adventurous and hardy souls go in there.

The *garimpeiro*, Brazilian equivalent of an Alaskan sourdough, digs for diamonds in much the same way early prospectors dug for gold in California and Alaska, sifting them from gravel dug out of the stream bed (page 698). In some streams or rivers he drives poles into

the bottom, in water as deep as 30 feet, and climbs down headfirst to get buckets of gravel from the bottom sand and silt.

This gravel is poured into sieves made of wood with fine wire in the bottom. These sieves let water and silt sift through, but catch the larger gravel. Then this residue is washed in a wooden pan such as gold seekers use. Diamonds, found among the coarse grains of gravel, are washed to the conical center of the pan by a rotating motion.

The diamond camps themselves are rough "boom towns," not unlike the frontier towns of the North American West. The men who inhabit them are hard and rugged: wind burned cowboys from the southern pampas, raff from the ports, veteran garimpeiros who have spent a lifetime prospecting for diamonds, and, of course, the usual complement of gamblers and camp followers, with a sprinkling of thieves and murderers.

During my first years in these camps I wandered from place to place as a gunsmith and dispenser of medicines. I had learned the mechanic's trade in the Argentine, and later an old one-eyed "thief taker"—one of the semiofficial law enforcement officers of Brazil—had advised me to pursue this business in the diamond fields.

"Any fool can find a diamond," he said, "and he will pass it on to the gambler, or the storekeeper, or a woman. But a man who lives by a trade will keep what he earns."

I found this to be sage advice. During the years I spent in the diamond camps I saw men acquire sudden wealth from the glittering gems—and lose it as fast as they found it. But the storekeepers, the diamond buyers, and the gamblers always prospered.

Only once did I deviate. In the little town of Areia, where I established myself in a small hut and made fairly good money repairing guns and providing such medicines as I had, I heard of a diamond strike one day. A Negro brought word from the upper country, near the Manso River, of a creek where diamonds could be scooped up by hand. Ernst and I joined the rush, as the entire camp emptied out on the trail to the north.

Spear Sometimes Safer Than Gun

It was my last attempt to follow the diamond camps. Within a few weeks I saw two men murdered and was attacked twice, by a knife thrower and a professional gunman. I had enough of the allure of Brazil's hidden treasures. In the summer of 1923, when my brother left to return to the diamond fields, I became a hunter.

Not for sport, you understand; killing animals for pleasure has never appealed to me. I killed only to eat or to defend myself or to protect the cattle of the great ranches along the Paraguay and the Parana Rivers.

These ranches, some of them the size of a small European country, lose as many as 6,000 cattle a year to the ravages of *tigres*, or jaguars. Naturally, the ranchers turn to native hunters, either half-castes or Indians, to run down these jungle killers and shoot them. I decided to join the profession.

Only the Indians are real experts, and they hunt the tigre with a spear. So I too learned to impale the big cats and also to shoot them with a bow and arrow. I decided that spear hunting was not merely more exciting than using a gun; it was safer.

The reason that it sometimes is safer to spear a jaguar than to shoot him is comparatively simple, once the fundamentals are understood. The area where the tigre roams is chiefly tall grass and jungle thickets. A tigre charging a man with a gun gives away only the initial advantage; if the first shot fails to drop him, the hunter may not have another chance. Frequently the charge comes so fast, and out of such complete cover, that the hunter is struck down before he can shoot. The spear hunter, on the other hand, meets the tigre in equal combat—his razor-edged spear against the animal's claws. If he is clever enough, the man will always win.

How to Track a Tigre

I learned my spear work from a wrinkled old Indian named Joaquim Guato, and I believe I am the only white man who ever did acquire this art. I met Guato at a small sugar plantation on the Rio Sao Lourenço. He was then about sixty, but a fabulous hunter. He moved in the jungle with the swiftness and silence of the jaguar itself.

From him I absorbed more on one trip into the jungle than many hunters pick up in a lifetime. I learned that, in tracking a jaguar, the paw marks are to be found near the edge of pools, in wet ground. If there is water above the foot mark in the swamp, the animal has passed within three hours; if the ridges around the toe marks are still wet, he is close by. In the open ground, or in sand, the time since the cat made the foot mark must be gauged by the amount of dew covering it or by cobwebs formed over the impression.

The tigre, he told me, is most dangerous in thick cover on the ground, where he is silent; in the open he will snarl when at bay, but in the tall grass he will growl and perhaps slink away. Seven out of ten will climb a tree; the other three will charge. A female with cubs almost always will charge.

Once, hunting with Guato, I saw him forced to deflect his spear as the jaguar turned in its charge. Leaping past him, the cat wounded

Author's Wife Rides a Strange Mount

[illegible]

[illegible]

Siegel's Dogs Strain to Go Hunting

[illegible]

Diamonds Emerge From This Mask

[illegible]

Down the Paraguay River and Up the Miranda: the Sternfeld 750-mile Migration Route

[illegible] ranch on the edge of the Paraguay proved too isolated for the adventurer, who needed close contact with fighting parties which he pulled [illegible] wife, children [illegible] animals aboard a log-chest and large and set off for Barranco Vermelho [illegible]

his dog. The old Indian knelt before the dying animal, cradling its head in his arms. I have never seen such a sorrowful look in the eyes of any man.

Man Against Man-eater

Otto Joaquim taught me how to deal with a charging tiger. He taught me to crouch, [illegible] with my knees close and [illegible] taking the charge and "giving [illegible]." The head-on impact of a 350-pound jaguar, he said, would otherwise sweep me off my feet, no matter how truly I planted my spear.

The spear is usually a [illegible]-foot blade with a [illegible]-inch crosspiece, fitted to a 6-foot shaft. The crosspiece prevents the spear from penetrating the body of the animal so deeply that its razor-sharp claws can reach the spearman.

The first time I witnessed a spear fight between a man and a tiger was on the edge of the jungle near São Lourenço. Joaquim [illegible] sitting beside that gave him the appearance of a [illegible]. His brown [illegible] rippled over muscles amazingly tough for a man of sixty. The hunter had followed his dogs, led by my Valente (which he had given me), into a patch of palms. The tiger we had been trailing suddenly appeared at the far end of the patch, facing the dogs and Joaquim. As he charged, Joaquim's heels

seemed to sink into the ground. This thin, lean little man, I felt sure, would be whisked into oblivion by the flailing claws.

I held my bayoneted rifle, not daring to shoot toward the whirling mass. Suddenly it became a fantastic wrestling match, as if the two were vying for possession of the [illegible] upon which the cat had impaled itself. Then—it seemed to be minutes, but it was only a matter of seconds—the tigre rolled over, and Joaquim was above the animal, pinning it to the earth.

First of 30-odd Spear Conquests

My first individual conquest of a tigre with a spear came many months later, when Joaquim had gone off on a hunting trip for a man-killing tigre in another area.

I was in the bush country, which is extremely dangerous for the hunter, since he cannot see the tigre until it charges. My dogs, running ahead, were baying at a cat in a thicket of brush. As I came up, I could hear its warning growl, which seemed to say, "Leave me alone and I will leave you alone!"

I had left my gun behind, and with only my spear I probed the thicket. The threat rumble seemed to come from [illegible] I was unable to locate. He [illegible] from which the beast would charge. Suddenly I saw a flash of tawny color at one side and swung my spear. The tigre came in low, which I had not expected, and I barely got my spear around in time to catch it in the throat.

With a frightful snarl the cat retreated, then came on again. This time, remembering Joaquim's warning to keep the spear low, I caught it in the chest. Within a few seconds I had turned it on its back and had my first kill with a spear.

Since then I have impaled more than 30 cats and shot more than 200 with bow and arrow or gun; but I have never quite experienced again the thrill of that first victory.

When I was "discovered" by Julian Duguid, the English writer, in the late 1920's, I had lived nearly 13 years in the Mato Grosso, almost out of contact with the civilization I had left. Duguid was travelling through the upper Paraguay country with two companions, one of them Manerto Urriolagoitia, who later became President of Bolivia. Duguid heard of me first as a "Russian engineer" who lived like a wild man in the interior, hunting tigres for the ranchers.

I could understand the bit about my being Russian. The natives had never heard of my native Latvia, and when I told them that it was close to Russia they just called me a Russian.

But I was no wild man. I lived in the jungle, it is true; but my neighbors were small ranchers or men who worked as outpost riders for the bigger cattle ranches. Nor was I a homeless nomad. I had built a hunting camp on the banks of the upper Paraguay River, with my own hut made in native fashion.

Acuri palm leaves were woven over lattice poles for a roof, and thick stakes driven vertically into the ground supplied the walls. Six or seven layers of palm leaves made the roof rainproof, and the walls, though well ventilated, were strong enough to keep out animals at night. The cabin was 12 by 18 feet, slightly larger than the huts of my camp helpers.

I had, in short, the necessities of life—a good roof over my head and plenty of food, including beef prepared the native way. The flooring of my cabin was packed with mud from terrible "garbilos." The saliva of the insects makes the dirt hard and firm, although not as hard as cement. Outside I rigged my kitchen under a lean-to.

Duguid and his companions planned to cross the Gran Chaco of Bolivia, which lies west of the Paraguay River and is in many ways a counterpart of the Mato Grosso of Brazil. It is a formidable region, with long stretches of waterless country, and is peopled with fierce Indians in the dense jungle interior. Few white men had traversed the Chaco, and Duguid and his friends felt the need of help and guidance.

I agreed to accompany the party. The trip proved not uneventful, and it resulted in Duguid's book, *Green Hell*. Upon its publication I received many offers to come to the United States and lecture on the wild, little-known country we had traversed.

Romance Comes to the Jungle

It was through these lectures, a decade later, that I met Edith Bray of Philadelphia. She saw my tigre-hunting film and, being slightly skeptical, decided to make the trip to the Mato Grosso and see for herself.

The first trip she and her friend Helen Post made to my jungle camp on the edge of a swamp lasted two months. In those months I began to learn what the calm courage, resourcefulness, and deep sense of beauty of a woman could do to a jungle home.

Later, Edith came back for a longer stay. We were married at Rio de Janeiro in January, 1940, and we found that a white woman, as well as a "wild Russian engineer," could become famous even among the Indians as a hunter of the jungle tigre.

On Edith's first hunting trip we tracked a mountain lion, or puma, until it finally retreated to the branch of a tree. It was sta-

A Jaguar, Its Jungle Bath Interrupted, Glares at the Camera

[illegible]

[illegible] drawn [illegible] could [illegible] see the animal [illegible] put [illegible] to [illegible] be [illegible] a [illegible]. I [illegible] her to wait [illegible] [illegible] stairs [illegible] she agreed.

"[illegible] I [illegible] was [illegible] now," [illegible] she shook her head.

"I don't want to shoot him—he looks so beautiful!"

I explained that this "beautiful" animal was one of the [illegible] beasts that had [illegible] the [illegible] of killing. [illegible] to have killed [illegible] sheep [illegible] more than [illegible] could eat.

This [illegible] I added [illegible] the [illegible] like the jaguar.

[illegible] "All right," [illegible] "I'll shoot."

She [illegible] an in- [illegible] and [illegible]. The [illegible] of the [illegible] dead before it [illegible]. She [illegible] white [illegible].

Mail-order Book the Only Doctor

Our [illegible] when we [illegible] the [illegible] lazy [illegible] that [illegible] following [illegible] of the [illegible] hospital in [illegible]. But [illegible] I [illegible] a [illegible] with [illegible] of [illegible] experience.

It [illegible] to [illegible] of [illegible] realize the impact of such an event upon [illegible] people, such as we [illegible]

The Author's Hounds Whine as Cassiano Oliveira Sharpens Their Appetites

[illegible]

planned from a [illegible] book entitled *The Forgotten Waters* [illegible] Edith had [illegible] arrival.

Cassiano, the gleaming [illegible] one of our camp helpers, [illegible] us to throw the hook into the Iguaçu River.

There is nothing [illegible] told Edith. [illegible] will prove. [illegible] Brazil.

The [illegible] was When [illegible]

We had already [illegible] greatly upon the crude camp facilities [illegible] available when Edith first arrived. Our camp was [illegible] bank of the river near the [illegible] [illegible] We had built an addition and expanded our [illegible] inside and showing the [illegible] of a woman's domestic touch.

However, we decided that the little hospital of the Sisters of Mercy in Cornélio should be the place of our first-born's arrival. Even with the [illegible] assistance of Sandra Cassiano, we placed our trust in the fact that a Brazilian physician would officiate at the birth.

We left [illegible] and proceeded to Cornélio [illegible] and five days later Edith gave birth [illegible] the hospital [illegible] three [illegible] born in the [illegible] as [illegible]

[illegible] was over. I [illegible] a [illegible] —a [illegible] [illegible] where [illegible]

The house [illegible] with a [illegible] palm leaves [illegible] like a [illegible] well [illegible] and the [illegible] clean and smooth. The [illegible] remained was 20 [illegible] feet [illegible] with [illegible] to be my workshop and the [illegible] bedroom for visiting hunters. A [illegible] I built two small rooms for [illegible]

Siemel's "Ark" [illegible] Across a Lake. This Short Cut North Stranded the Expedition

[illegible]

[illegible] and [illegible]

[illegible] quickly [illegible]

[illegible] depended on [illegible]. We went as [illegible]

[illegible] to understand some of Noah's problems in [illegible] the Ark.

Our camp at this time had become quite [illegible] and livable. In fact, it had [illegible] into a tiny settlement. In addition [illegible] with [illegible]

[illegible]

"Andalis" Make Good Ovens

[illegible]. She had [illegible]. Edith insisted that [illegible] followed up [illegible] habit with cloth coverings for the tables.

We did not have wood floors [illegible], because insects [illegible] every covered place in the jungle [illegible]. However, we [illegible] an exceptionally good job [illegible]

8 Choked Marshes Compliance Travel by Houseboat

[illegible]

9 Oscar Blazes a Trail Through Axle-deep Grass

[illegible]

ture until the floor was hard enough to be kept smooth and clean.

Even after we moved to the houseboat, which we named *River Gypsy*, we continued to cook ashore, using an outdoor fireplace I built on the riverbank. The fireplace stove was a shallow hole cut into the edge of the bank and lined with rocks which I had chipped into blocks. A grill and iron plate provided both open-fire and stove-top cooking space.

But Edith's pride and joy was her "mud oven." It consisted of a vacated termite mound six feet high, built like a stubby silo and baked to almost concrete hardness under the tropical sun. It stood on high, dry ground, a few feet back of our hut. To transform it into an oven, I had merely chopped out a door, scooped out the honeycomb interior, and cut a hole for a chimney.

The camp near Descalvados had become home to Edith and me. But besides being in a swampy area, it was remote from civilization, and I had become increasingly interested in guiding hunting parties into the jungle. Few hunters would come to Brazil during the war, and Brazilians would not ordinarily travel so far into the interior to hunt. Our only solution was to move nearer to our customers and to better means of communication.

"Siemel's Ark" Sets Out

We planned to embark in August of 1942. Our second child, Dora, was then about three months old and able to travel. The houseboat would carry the women and children.

Lauro and Rosendo had roped together several dugouts, making a barge upon which we loaded the animal cages. There were three tiers of cages, housing two jaguars and an assortment of other animals, including an anteater, a sloth, and a coati. We also had a collection of parakeets, macaws, and chickens.

The barge was powered with a 5-horsepower outboard rigged on an 18-foot dugout. My little speedboat, of 72 horsepower, was lashed to the houseboat, and I envisioned its great power maneuvering the *River Gypsy* with ease.

On a bright August day—it was mid winter south of the Equator—our Noah's Ark fleet was ready to embark. A small gathering of cowboys from the Descalvados Ranch collected on the bank to see us off and to help.

The barge, with its load of bawling, cawing, cackling passengers, put out into the stream first and was well on its way downstream, with the dugout chugging manfully on its stern quarter. It seemed a little ridiculous for the tiny scooped-out log to be nudging this bulky craft along the river, and as a matter of fact the barge traveled at little more than the speed of the current. Nevertheless, it looked like a magnificent start.

As I noticed the rather ponderous pace of the barge and its escort, I had a secret worry. I knew that we would meet a zip current at the confluence of the Paraguay and the Miranda, where we would have to turn the craft from downstream on the Paraguay to upstream on the Miranda. It was possible that the chugging dugout might encounter some difficulty in maneuvering at that point.

However, I quickly dismissed the worry. We were about to embark, and I roared cheerfully to the helpers alongside:

"Cast off!"

On the houseboat were Edith and our two children, Dora in her crib and Sahota eagerly watching from the rail of the deckhouse. The wives of Lauro and Rosendo, who were ahead of us in the barge, were also aboard, plus their total of eleven children, plus five cowhands I had hired for the voyage downriver. I stood on the roof of the houseboat, directing operations. Edith was at the helm of the powerboat, which was lashed against the stern.

Down the Paraguay, in Circles

I had planned to navigate the first few miles from my position atop the houseboat roof. But after a few minutes I was not sure I was going to have anything to navigate. Edith rammed her foot on the starter when I gave the signal, and the powerboat soon roared noisily alongside. But nothing happened. The houseboat remained glued to the riverbank.

"Warp the wheel!" I shouted to Edith.

Edith reversed the steering gear, and the nose of the powerboat turned against the barge. My idea was to drive the stern inshore and point the bow into the river.

Slowly the big houseboat turned. It continued to turn. Within a short time it had completed a circle, and the prow was pointed toward the bank.

"Take it slowly!" I called to Edith. "Put the wheel over; we're going into the bank!"

Edith, wrestling desperately with the little craft, tried to follow my directions. She managed to get the wheel over, and after a few seconds it seemed as if the powerboat would swing itself into the bank. Then the *River Gypsy* gained way, and we began to revolve in the other direction. The cowboys on the bank shouted encouragement.

Finally I gave up. I called down to Edith to kill the motor. It was obvious that the little powerboat, speedy though it might be alone on the river, was not cut out for the heavy-duty job of guiding the big houseboat.

I climbed down into the powerboat, cast loose from the houseboat, and roared downriver after the barge, which was now around

One Mistake Here Could Mean Quick Death from Carnivorous Fish

[illegible]

[illegible] food, and slowly the barge wheeled around and headed back upstream.

[illegible]

[illegible]

[illegible] second, and final, [illegible] on the weirdest water voyage in the history of the Mato Grosso.

I knew Edith had [illegible] sorrow at leaving the Indians [illegible] little [illegible] of [illegible] with the [illegible] of the river-bank, [illegible] farewell. Little Sandra [illegible] suddenly [illegible] 2. Marriage

Two Howling Monkeys and One Remain, Are Brought to Dinner by Hammock

Gregarious howlers convene in the jungle be the dozen. Their strange cries sound like the rumble of a railway train. The Indians found it impossible to raise howlers in a corral; a tree proved just the thing

During the first few days we had only one real incident. One of Canaria's little girls fell into the water, and I had to dive in after her. I wasn't worried about the swimming part of it. I was worried about the piranha, the vicious, flesh-eating fish which strikes in swarms that skeletonize within minutes any body they attack.

Accident Has Happy Ending

I managed, however, to hand the little girl until Rosendo and Lauro had board boat in a long arc and brought them along-side. We hauled the half-unconscious child aboard and after a few minutes had her breathing normally. Her mother stood by, alternately weeping and scolding.

I glanced up at Edith. He[illegible] she had stood in tense silence while I was being pulled aboard, knowing that at any instant the piranhas might scent an animal body in the river and make their deadly assault.

All she said was, "Sasha, let me bring you the bottle of rum."

Each night on the voyage downriver we pulled up along the bank and cast anchor. We did not go ashore, although it would have been easier to prepare food on the ground, chiefly because Lauro, Rosendo, and the cowboys wanted no encounters with jaguars.

Fortunately, we had a big iron kitchen stove on the houseboat, and this served to provide food for the entire assemblage, which, including the children, numbered 24.

Our supply of staples included the usual beans and cassava flour, sugar, rice and *charqui*, the dried beef from which the "jerky" of North America's West derived its name.

In addition, we were able to shoot some game ashore. Along the Paraguay banks are many little colonies of capybaras, large guinea-pig-like animals. These are the world's largest rodents. Some explorers have not liked the flesh but we find it excellent, tasting like [illegible]; it forms a readily available source of fresh meat along the river (opposite page).

We had been on the way less than a week, and had covered less than a fifth of the distance when we reached the mouth of Cara Cara River, a cutoff which our pilot, Carlos, assured us would save at least a week of our voyage. The river slows across from the [illegible] to the east, and one branch [illegible] the mouth of the Cuiaba [illegible] where Juan on Cuiaba had first [illegible] the art of spearing a tiger.

[illegible] Cara Cara is not wide [illegible]

Anteater's Tail Is a Fifth Arm

[illegible]

Tapirs Cousins Are Horse and Rhino

[illegible]

The Largest Rodent Grows to 150 Pounds

[illegible]

Jungle Heat and Tree Made of Palm Leaves Fail to Dim the Joy of Christmas

[illegible] "Silent Night" [illegible]

[illegible] few miles [illegible]. However, as our strange [illegible] upward, [illegible] gently by the [illegible] we began to see patches of [illegible] water [illegible] with [illegible] and marsh weeds.

Carson, [illegible] planted himself [illegible] in the [illegible] of the [illegible] and [illegible] was [illegible]. [illegible] with [illegible] and a [illegible] He took [illegible].

It was not long, however, before it became obvious that Carson was not so familiar with the [illegible] as we had supposed. We threaded the narrow passages and suddenly emerged upon a lake almost completely green with water plants. [illegible]

I walked down to [illegible] came running back, [illegible] a [illegible].

"[illegible] Silent Night" [illegible]

I explained that [illegible] explained [illegible] which [illegible]

"You animal!" he roared. "Why do you not dive in and eat the grass ahead of us?"

I quickly pacified Carlos. We were in a serious predicament, and I did not feel that any display of temper would help. Finally we marshaled all hands, and with long poles, known as *varas*, which Lauro and Rosendo had provided, the boat and barge were pushed gradually across the clogged surface of the lake to clear water beyond.

"Ark" Hauls Herself Through Water Plants

Our second encounter with water plants occurred a couple of days later, and this was more serious. The *River Gypsy* slipped and scraped over the first obstacles, then seemed to have settled herself for a long rest. The little vagrant's outboard churned the water furiously, but neither pole nor motor power budged the ungainly floating a foot.

Finally we sent two men ahead to pull the plants from the channel as much as possible (there was still some water between the bottom of the houseboat and the bed of the river), and Lauro and Rosendo rigged the anchor so that it could be carried ahead and fastened in the bottom. Then, using a hand winch at the forward end, we were able to kedge off the marsh bed, yard by yard, until we were clear again.

After hours of work we managed to reach the far edge of the tangled growth of marsh weeds, and once more the *River Gypsy* and her escort rode proudly down the Cara Cara.

A week later, after following a tortuous course through several lakes and creeks, we emerged upon the broad Paraguay. From this point south to the mouth of the Miranda our trip was fairly routine. We veered east of Corumbá, through an estuary known as the Paraguay-mirim, since I did not want to encounter the rush of small boats that might put out from the town to see the floating memorials I was taking south.

Trouble at the Rivers' Crossroads

For several days our trip went serenely, until we came to the point where the Paraguay-mirim and the Paraguay merge again. We were now 800 river miles south of Dessalvados and 100 miles from the junction of the Paraguay and the Miranda, where I knew our greatest troubles lurked. The river below Corumbá is nearly a mile wide, and the wind often howls along its broad expanse in fierce gusts.

We kept our river caravan close to shore, and at one point, as we passed a settlement near the end of the Paraguay-mirim, we had to lay to for three days while the winds buffeted the open water of the river (page 7023).

A hundred river miles below Corumbá lie Porto Esperança and the railroad. After we moved back into the main stream of the Paraguay, we hung out running lights at night because we occasionally sighted other boats.

Some 30 miles above Porto Esperança the Miranda pours from the east into the Paraguay.

I was squatting on the forward end of the houseboat, with Edith beside me, when I first sighted the mouth of the Miranda, beyond a sand on the eastern shore. This was the most treacherous part of our voyage, since we were now required to turn the *River Gypsy* and its attendant barge into the mouth of the Miranda against the current, before the double force of the Paraguay and the Miranda should sweep us on to the southward.

Our river entourage, which we now called "Noah's Ark," could move with some ease with the current, but when it came to maneuvering across the current [illegible] horsepower motor might be a little less than adequate.

Manpower Chases the Flotilla

I called out to Lauro: "Bring out the poles!"

Suddenly, however, the current quickened, and we fairly shot toward the river mouth, with Lauro bawling to the hands to grab their poles from the racks and get set for the crisis. But in the next minute the rip from the Miranda had caught us and swung the 80-foot flotilla broadside. The north bank of the Miranda, where I had hoped to make my turn, swept past and swiftly receded. Suddenly Bertardo, one of the helpers, shouted from the forward end: "Boss! There is bottom! I have my pole!"

He had thrust his pole down to starboard and was lustily pushing on it. Two others, on the same side of the barge, had also reached bottom, and within a few seconds the combined braking power of the poles stopped the forward movement of barge and houseboat.

Slowly they began to edge the *River Gypsy* toward the mouth of the Miranda, only a few hundred yards away. With Lauro organizing the crew, the men worked in relays, pushing their poles along the sides so that the boat moved forward at about the speed they were walking.

Poling a combined barge and houseboat upriver is no child's play, and it proved to be an especially tough chore for my boatmen, who were accustomed to taking the course of least resistance—downstream. Lauro's crew of polemen trudged up and down the narrow deck of the houseboat with growing disgust. Their only relief came at intervals when the dugout, with its heroic motor, proved able to keep the barges under way.

As the river narrowed, the flat country, baking under the spring sun, began to close in on us. It was hot, but beautiful. Along the banks blossomed great patches of scarlet and purple *pitia*, those startling flower-trees which appear like massive bouquets in the tall grass of the marshland.

After many days of this laborious progress our flotilla rounded a bend, and I saw the site of our new home—Barranco Vermelho, or "Red Cliff," crowned as with a royal garland by purple pitia trees.

We found a mooring spot for the *River Gypsy*, and the children, babbling with excitement, clambered down and scurried up the embankment. We were met by a blond man on a horse, Raoul Nesheim, manager of the Miranda Estancia. He waved cheerily the customary greeting of the Brazilian ranchero, to whom courtesy is a habit, be he of Portuguese, Spanish, or other descent.

Barranco Vermelho became more truly our home than any other place in South America. It was not as deep in the jungle as Desalvados and perhaps not as wild; but it was sufficiently remote from civilization to lure hunters, and it was filled with a quiet beauty that only untamed Nature can produce.

Christmas Comes to Red Cliff

The first three years at Barranco Vermelho were hard. The building of a camp is not easy, and Edith and I worked industriously to make our place pleasant, both for the children and for hunters who came to stay with us. Each Christmas we spent at the Miranda Estancia as guests of Senhor Nesheim.

But on our fourth (and, as it turned out, our last) Christmas at Red Cliff, we decided to celebrate the holiday at home. For two weeks it rained. Christmas morning itself, however, dawned bright and clear.

Edith had prepared the atmosphere the night before with a jungle-bed version of *The Night Before Christmas*. For the more orthodox reindeer she had substituted our local swamp deer. But explaining snow proved to be a nearly insurmountable problem. If anyone wishes to test his descriptive powers to the core, let him try to describe snow to children who have never seen the stuff.

However, we fixed up a Christmas tree, which I turned out in my workshop, using a lathe-turned length of mahogany for a trunk. I bored holes in it and pegged in palm leaves for branches. We made the proper trimmings out of tinfoil, with which packages often are wrapped for shipment in hot countries, and cut the tops of cans into glittering disks and stars for ornaments. Candles, of course, were no problem (page 710).

Lauro, Rosendo, and I spent many hours carving toys, creating sets of blocks for Dora and more advanced jack-in-the-box and monkey-on-a-stick contrivances for Sandra. Other gifts included homemade dolls, and parcheesi and tiddlywinks sets contrived from caymun teeth. The women strung necklaces of shells, which delighted the children.

When it came to playing Santa Claus in traditional costume, however, I rebelled. The mere thought of a red-robed Santa with a woolen cap and a pillow, all in a 100° temperature, was enough to send perspiration coursing down my face.

Christmas dinner was unorthodox, too, but savory: breast of guan, a pheasantlike bird, with wild rice; roast *mutum*, or curassow, a bird nearly the size of a turkey; and finally a roasted peccary, the jungle hog, served on a huge wooden slab with cassava cakes around it in place of potatoes and a jungle fruit in its mouth.

Edith and I agreed later that from the moment the children had come pattering into the room in the morning, wide-eyed at the wonders that Santa had carried all the way down from the North Pole, until we tucked the sleepy tots into their beds that night, Christmas in the jungle had been an unqualified success.

The following June, Sashinho was born, and Edith and I decided it was time to let our little family see something of life beyond the jungle. So, in January of 1947, more than seven years after Edith had arrived on her second trip to the Mato Grosso and decided to make it her home, we closed the *River Gypsy*, packed what things we thought we should take with us, crated the animals which I had contracted to deliver to North American zoos, and boarded a downriver launch for Porto Esperança and the train to Rio de Janeiro.

Two Magic Lands

I shall never forget the final scene: our barge, made of dugout logs, piled high with trunks, crates of animals, and general camp equipment; Rosendo at the controls of the outboard motor in the dugout, which was lashed to the barge; Cenaria and Antonia waving from the bank, surrounded by their constantly increasing testimonials to Brazil's national habit. Florisbal, the children's nurse, her dark eyes filled with tears as she clasped her own baby and waved her blessing to all of us.

We had left our jungle home and were heading for a wholly different one in the United States. To Edith and me, it meant farewell to a magic land; to little Sandra, Dora, and Sashinho, the magic land still lay ahead.

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Articles and photographs are desired. For material The Magazine [illegible].

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[illegible] historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date [illegible] November 4, 291 B.C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U.S. Army Air Corps, the world's largest balloon, Explorer II, [illegible] Capt. Orvil A. Anderson took aloft in the gondola [illegible].

[illegible] in the history of astronomy was launched in 1949 by The [illegible] Palomar Observatory of the California Institute of Technology. This project will require four years to photograph the vast reaches of space [illegible] the first sky atlas for observatories [illegible].

In 1948 The Society sent seven expeditions to study the sun's eclipse on a 5,320-mile arc from Burma to the Aleutians.

The National Geographic Society and the Royal Ontario Museum [illegible] meteor crater, 11,500 feet in diameter, in northern Quebec.

The Society granted $25,000, and in addition $75,000 was contributed by individual members, to help preserve for the American people the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California.

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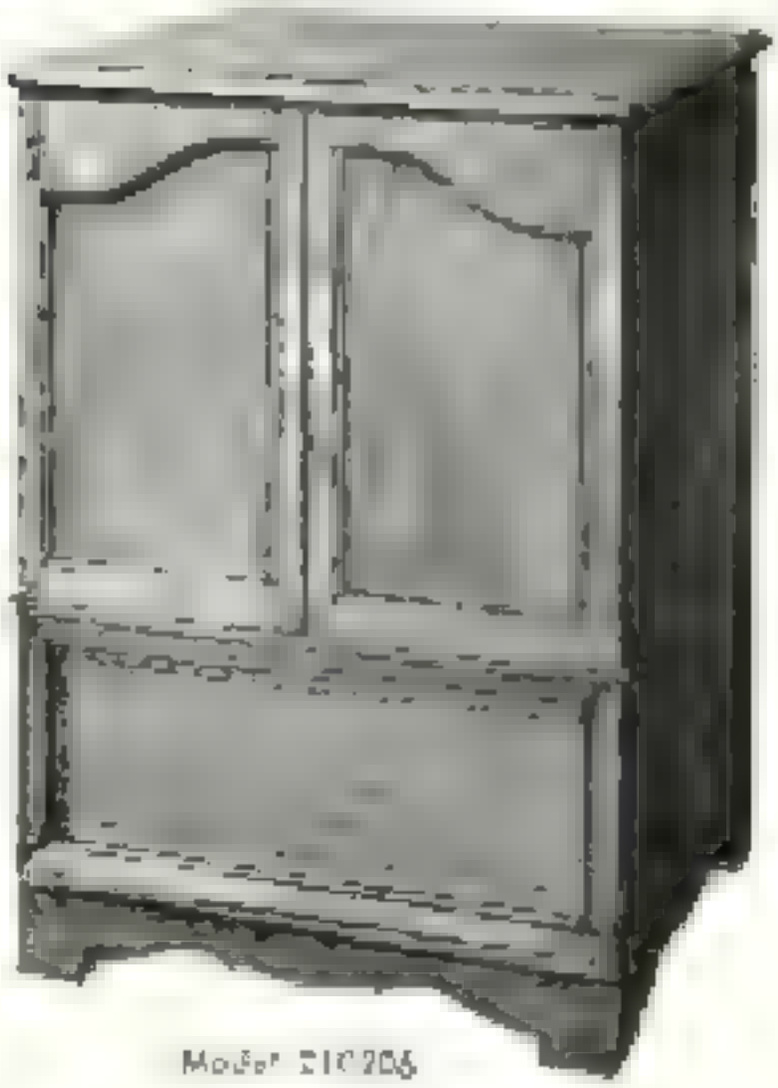

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Longfellow's home was an historic dwelling that had been built in 1759 by a wealthy Tory. Commandeered during the Revolution, it served as Washington's headquarters for a lengthy period. On Longfellow's marriage in 1843 the bride's father purchased the house as a wedding present for the couple.

Longfellow's works were translated into many foreign languages and he was the first American to be commemorated in the Poets' Corner in Westminster Abbey.

When, in Longfellow's honor, the local government cut down the spreading chestnut tree immortalized in his poem about the village blacksmith, the schoolchildren presented him with a massive armchair carved from the wood. In acknowledgment, he composed "From My Armchair" [illegible] each young visitor [illegible] sat and received an autographed copy of the poem.

After his death a group of Indians came to visit his home and sent his family an invitation to attend their presentation of "Hiawatha." Written on birchbark in Ojibway, it said in part: "We loved your father. The memory of our people will never die as long as your father's song lives, and that will be forever."

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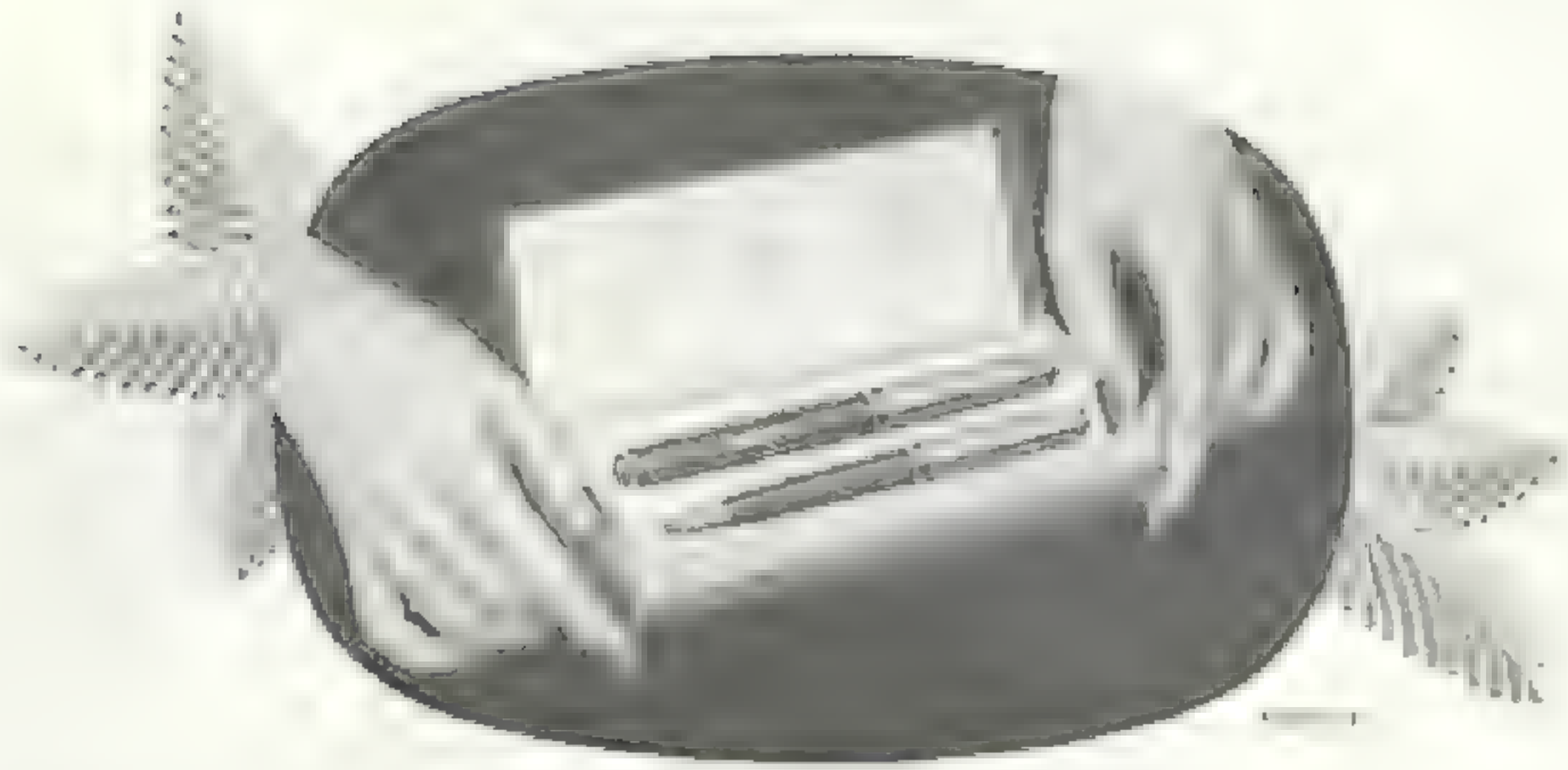

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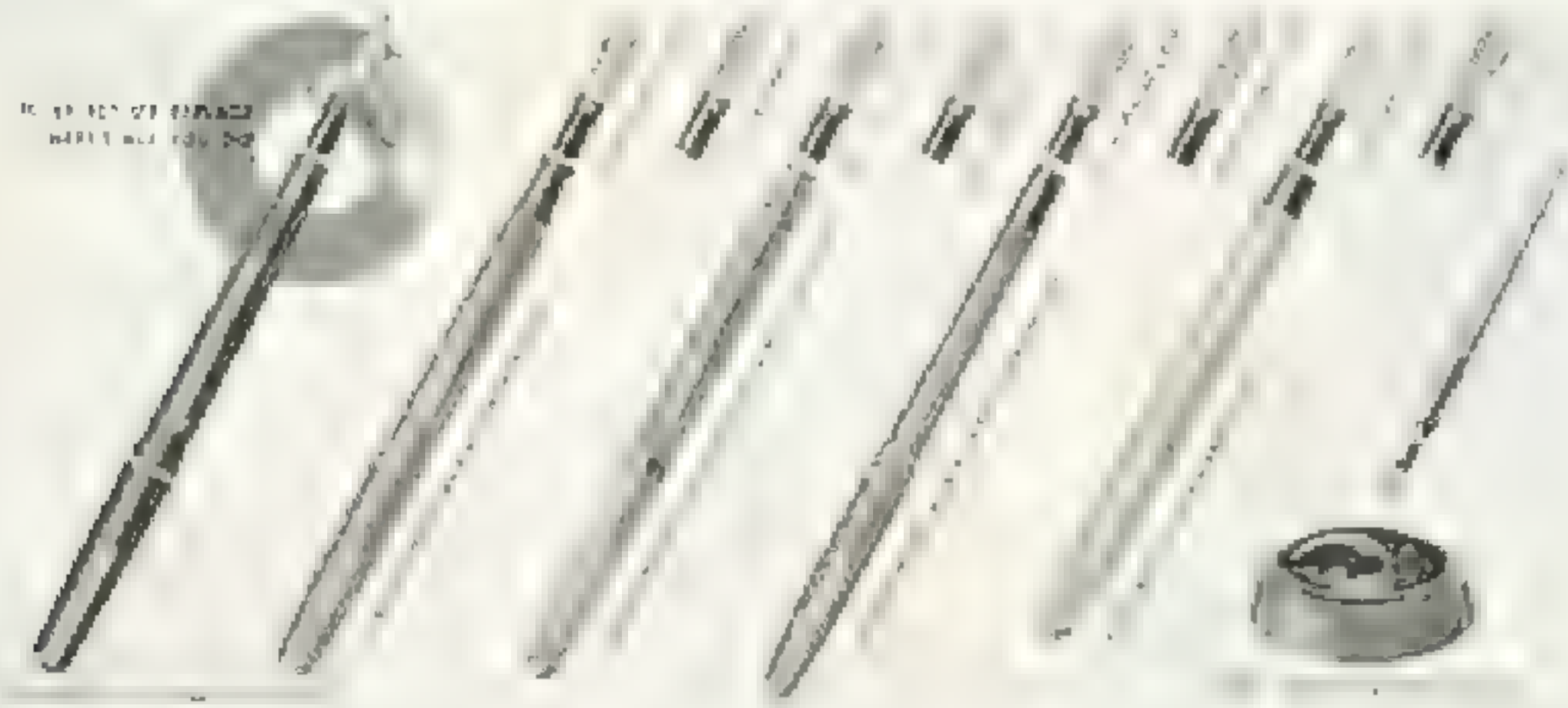

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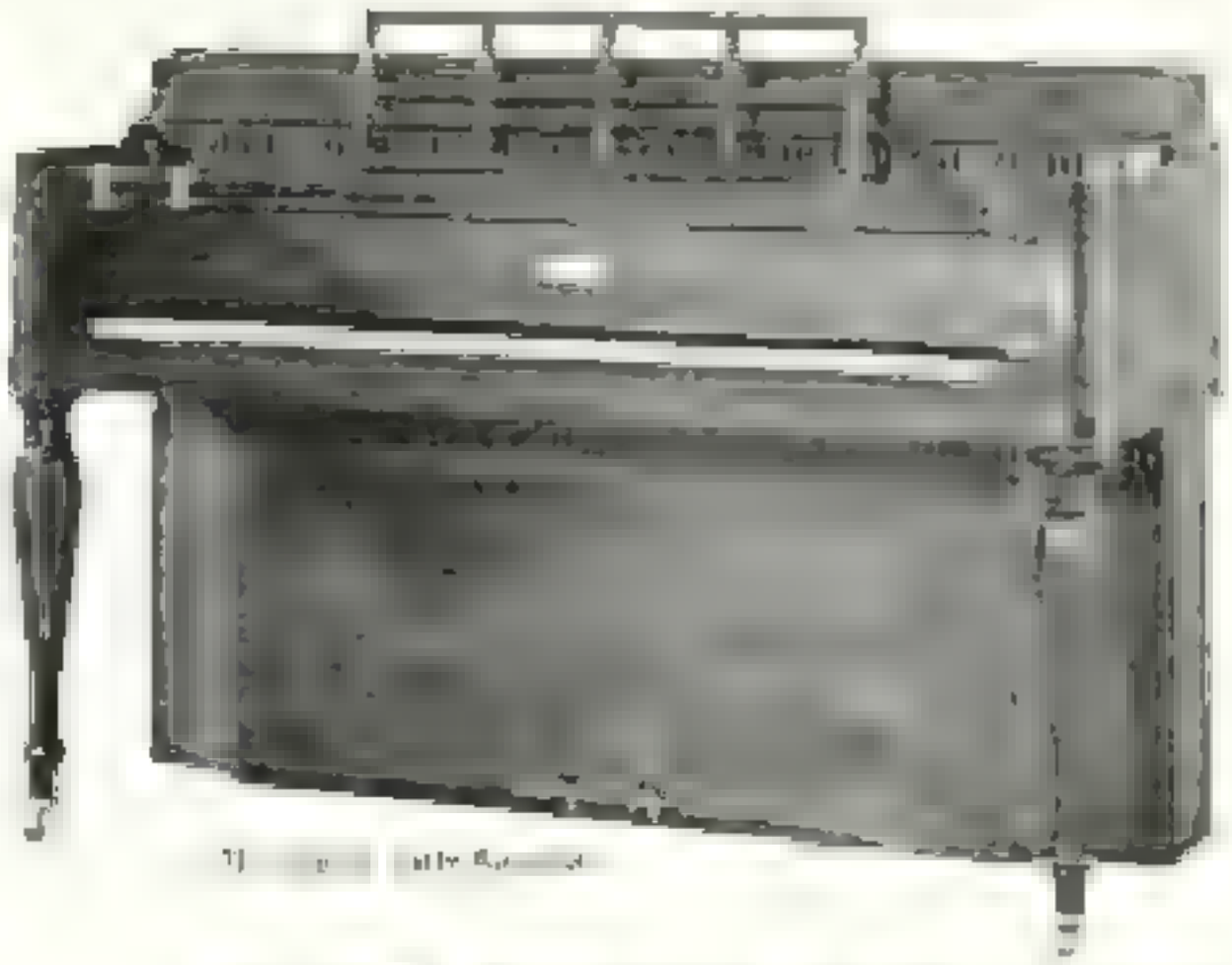

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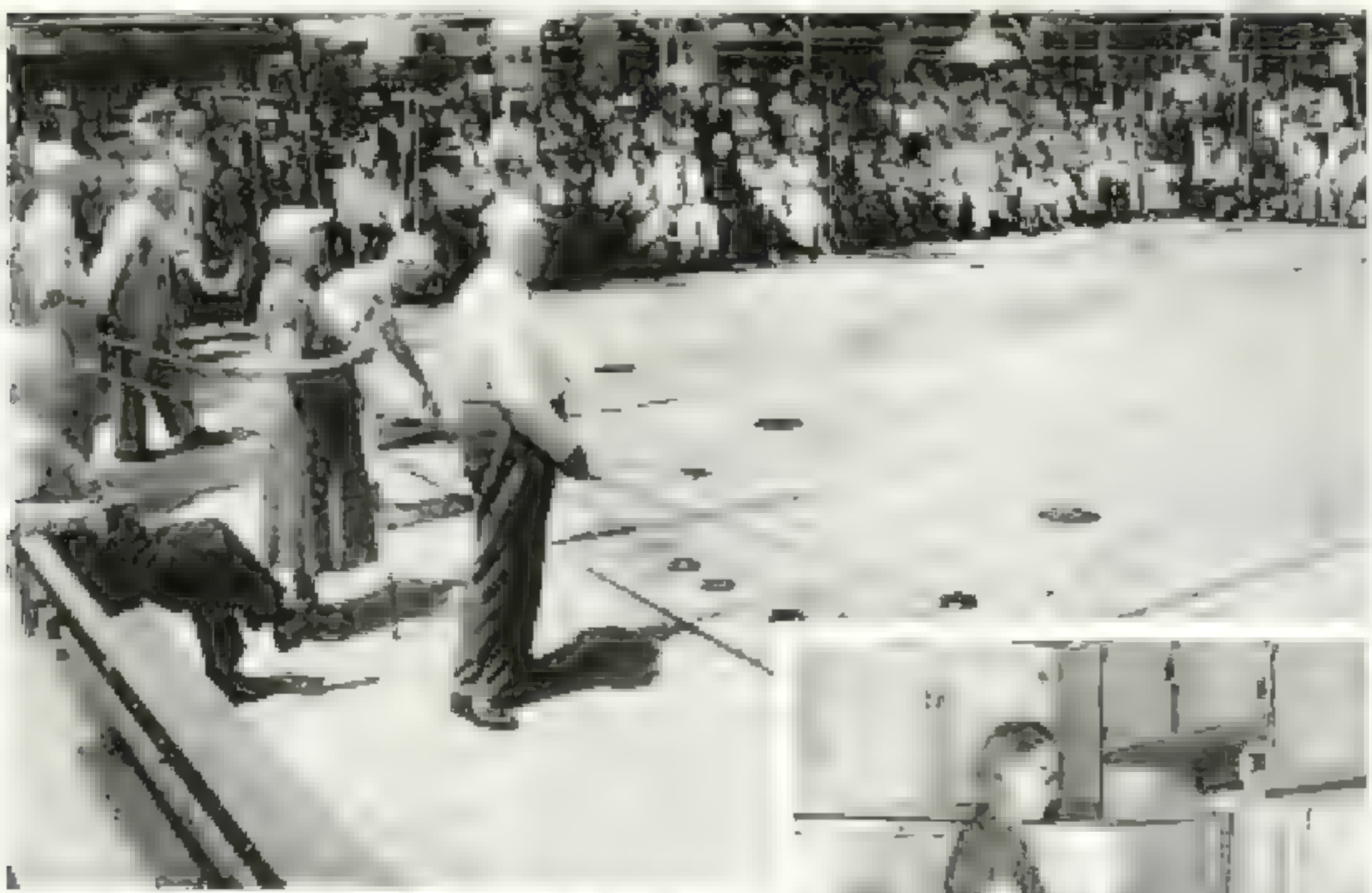

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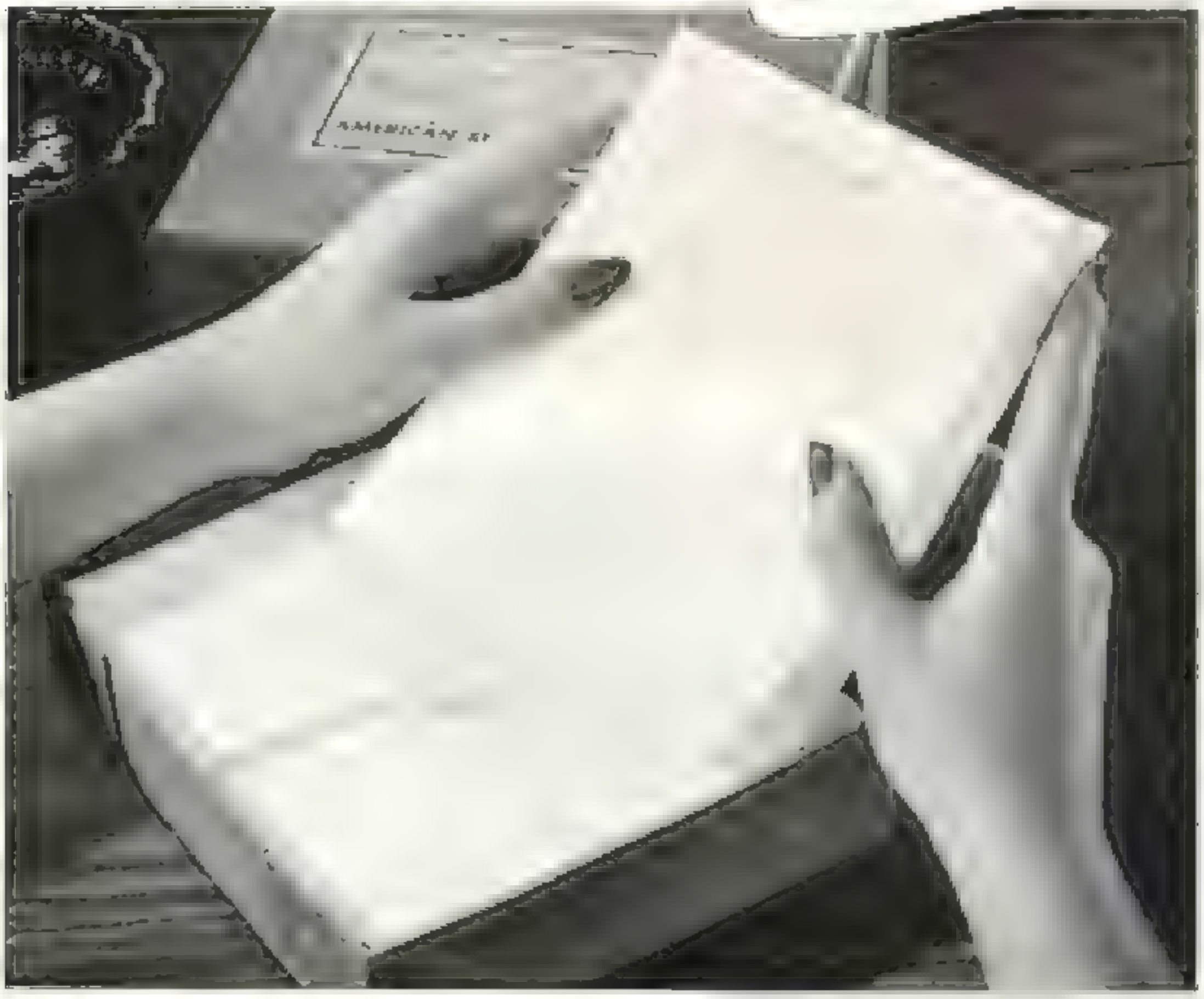

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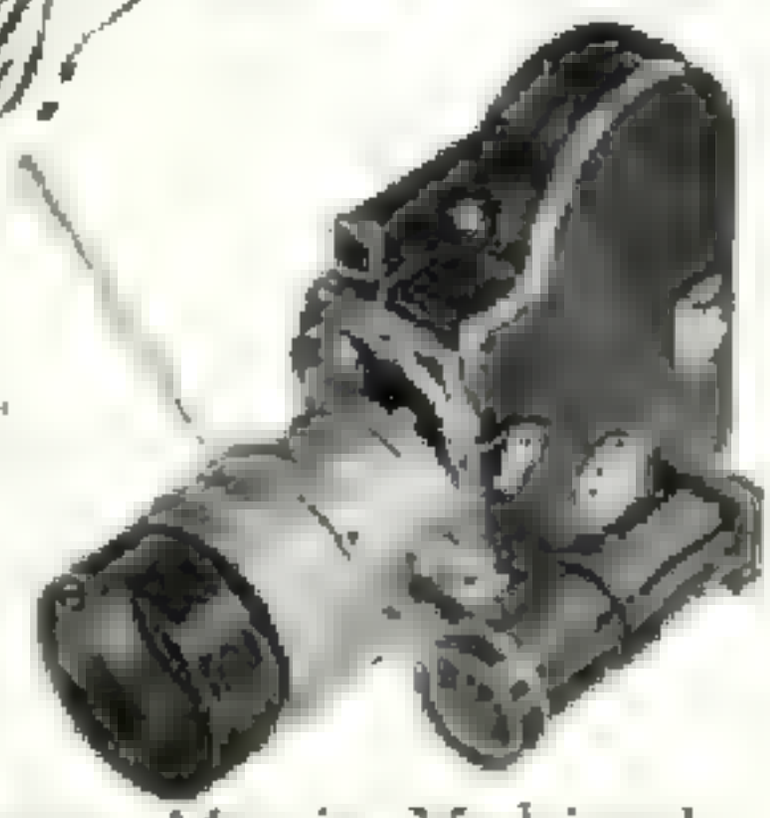

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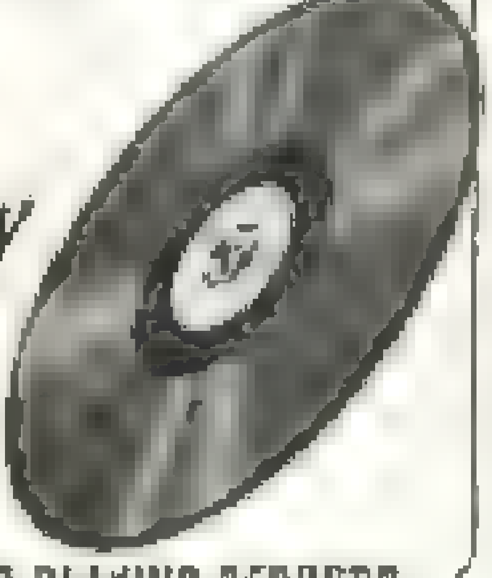

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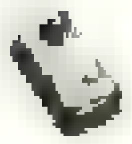

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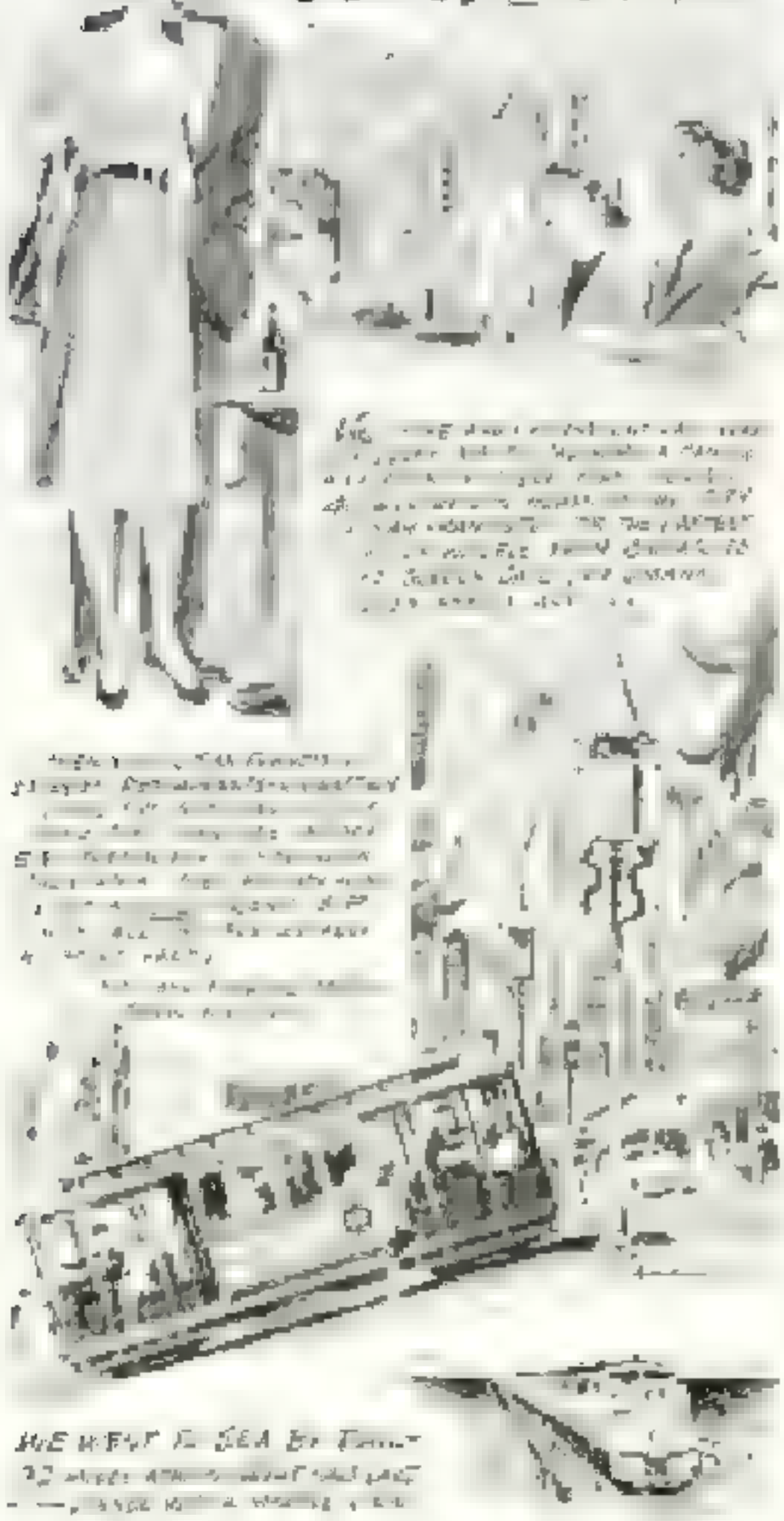

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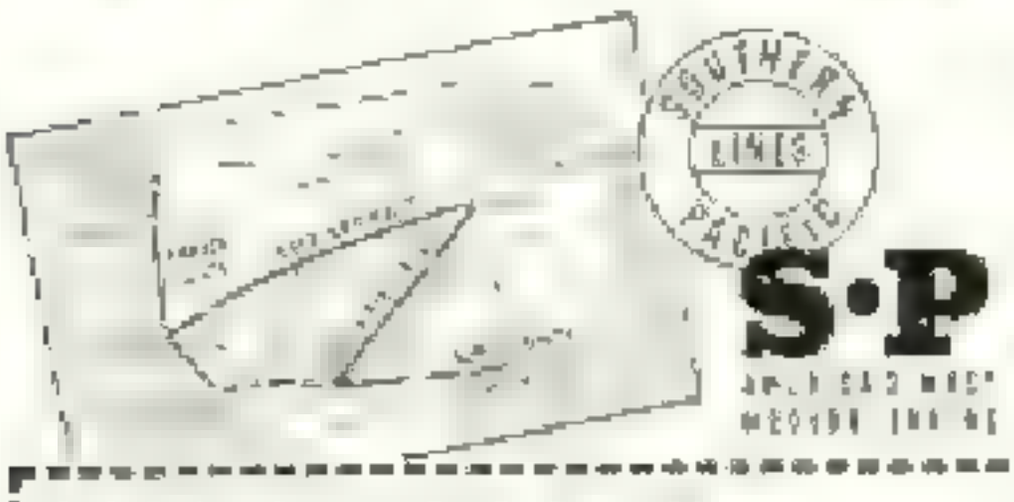

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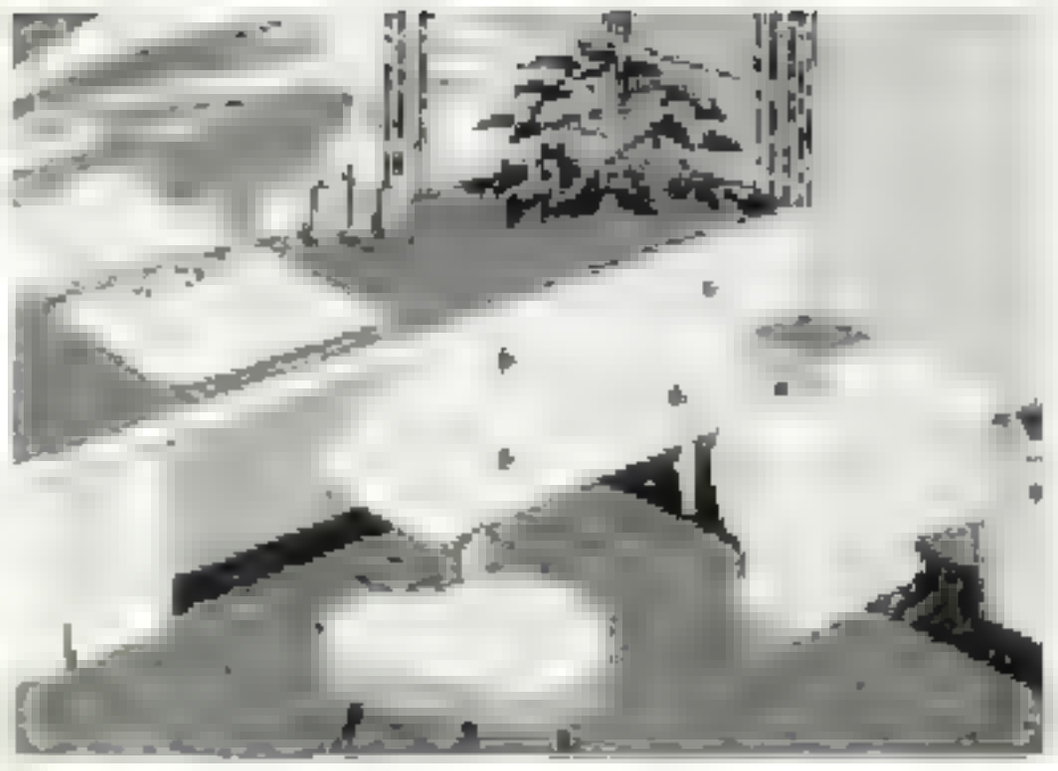

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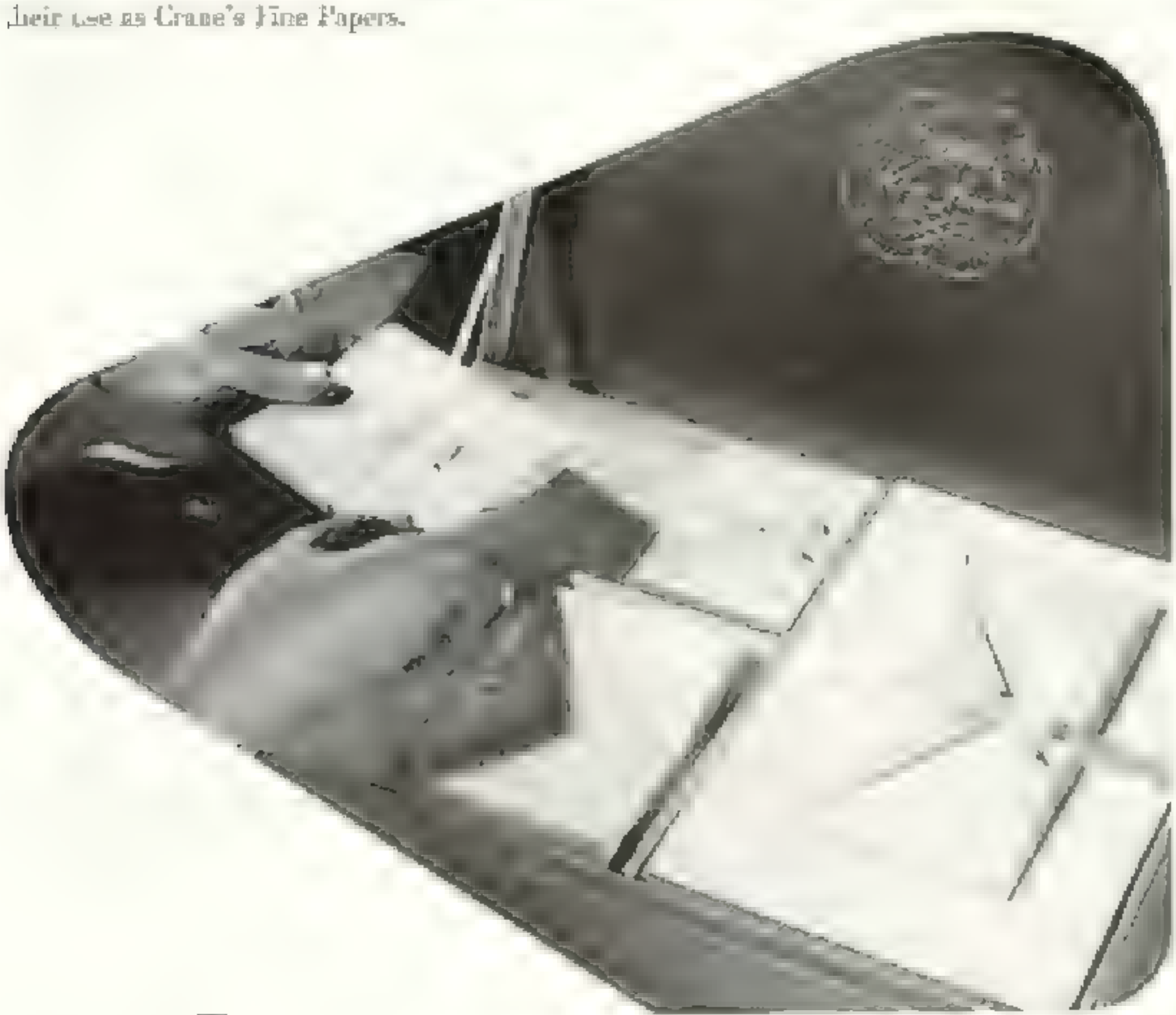

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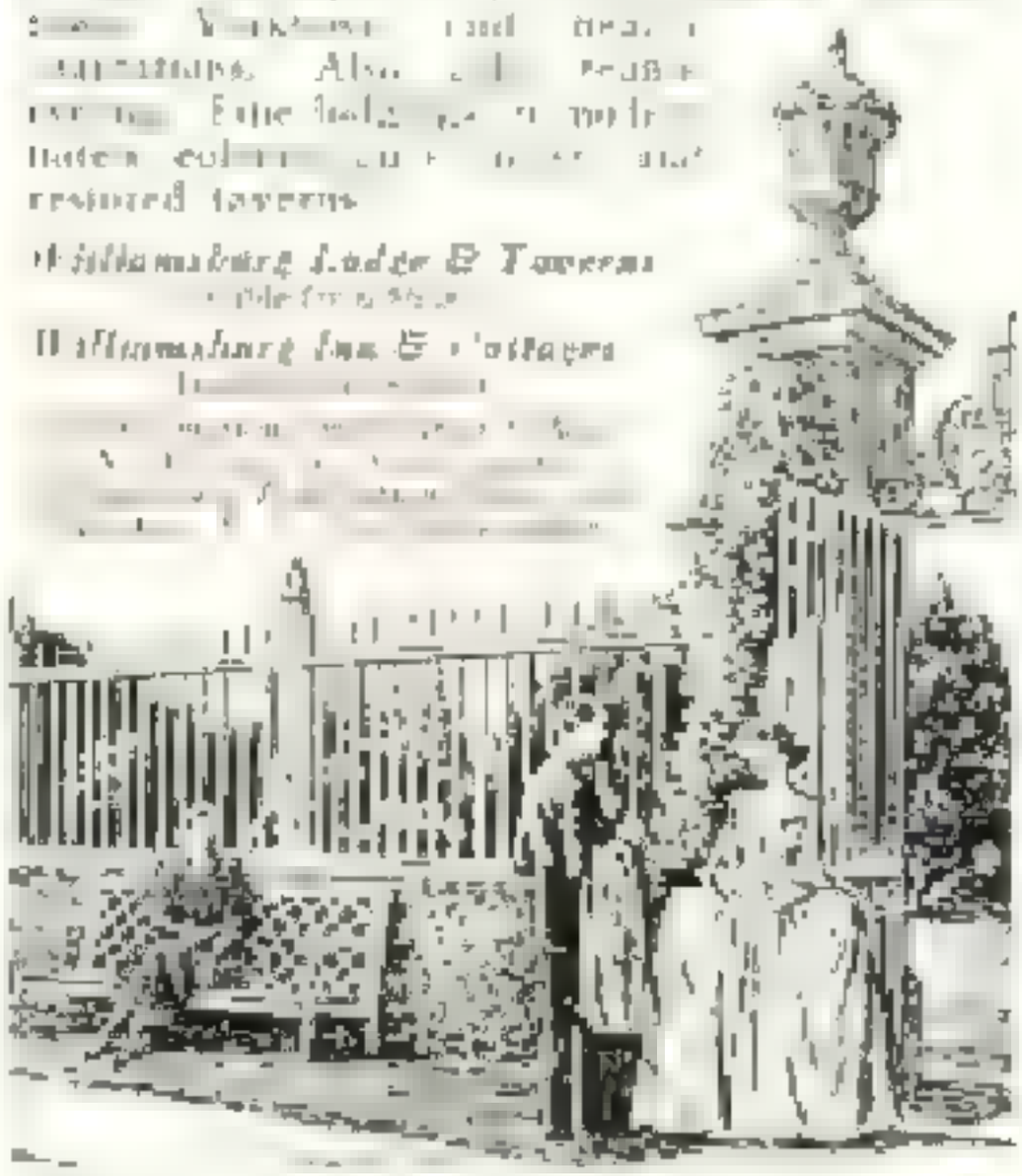

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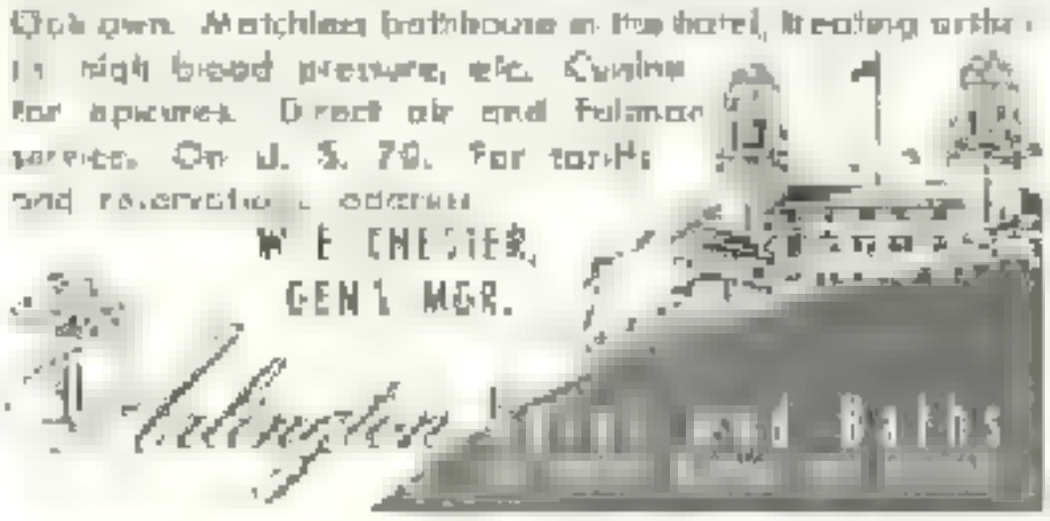

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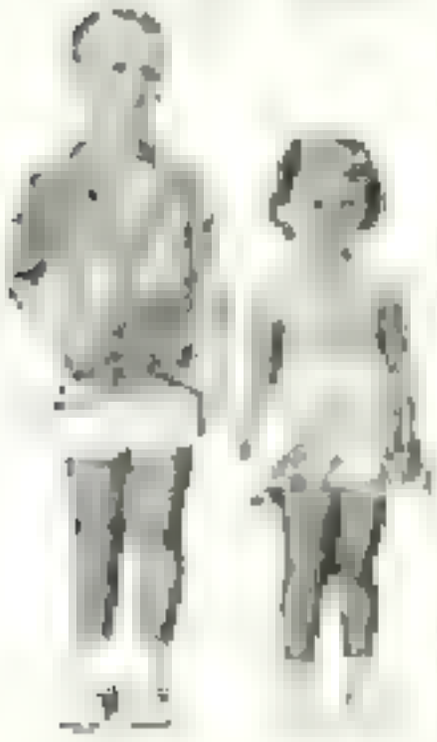

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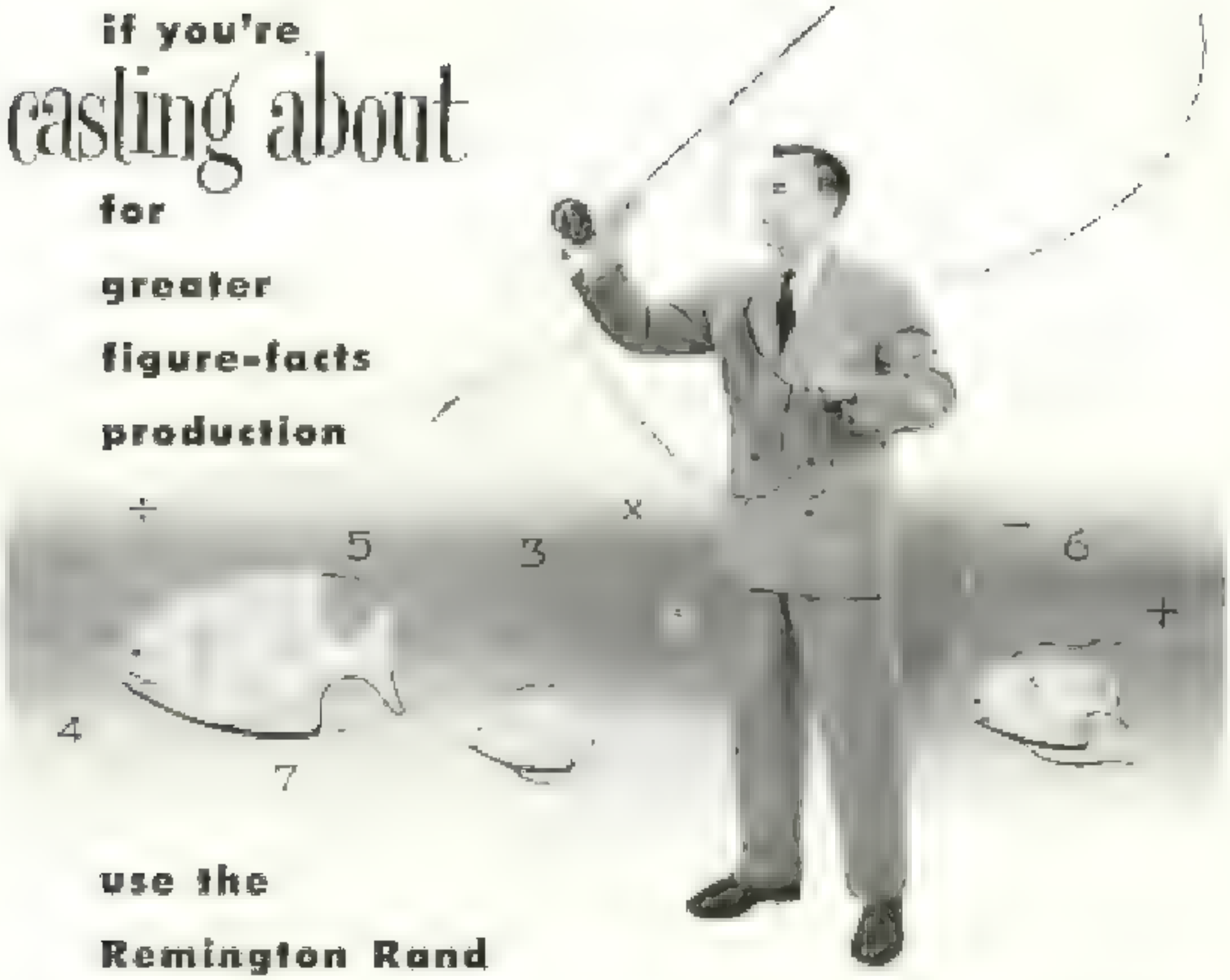

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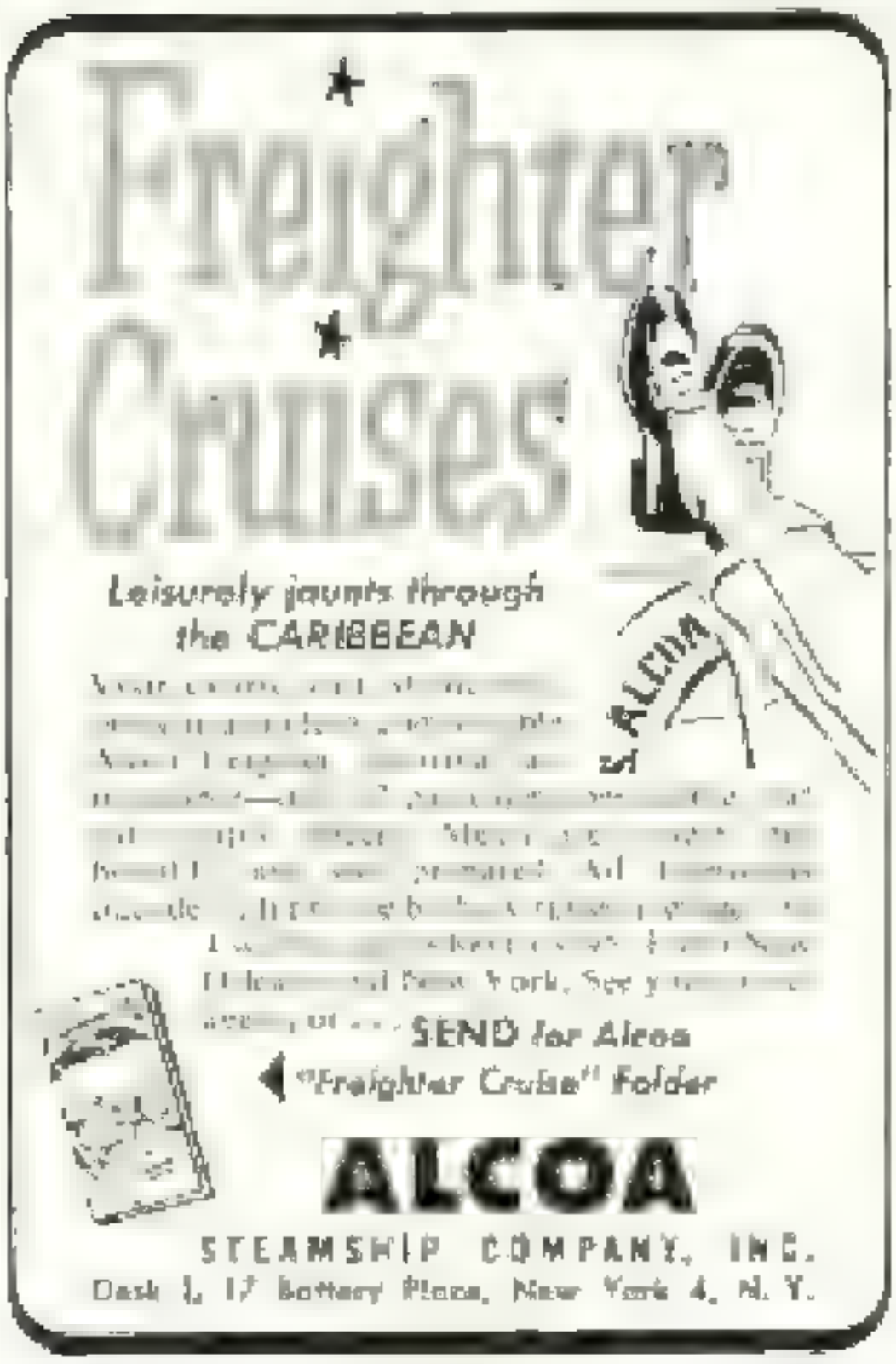
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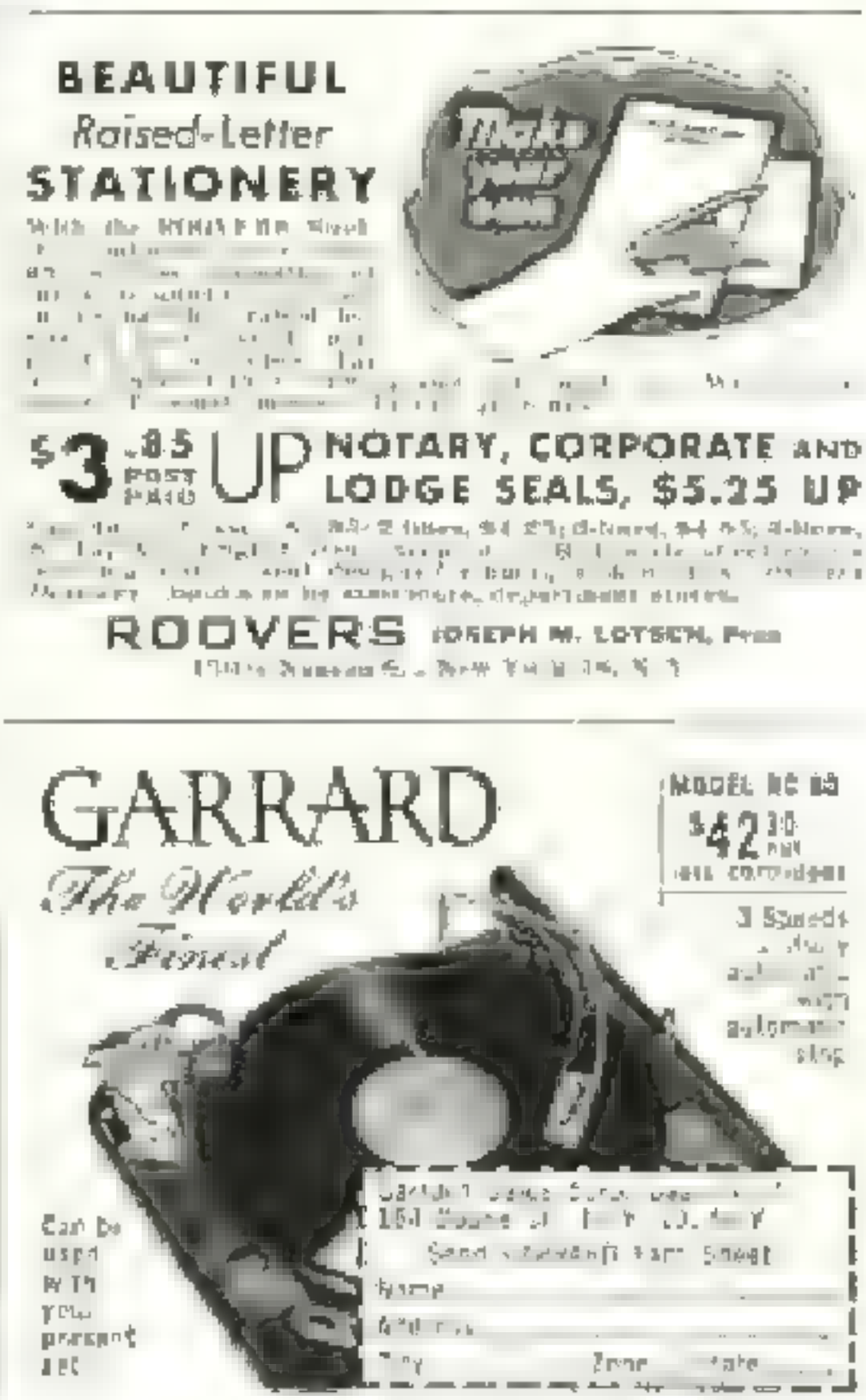
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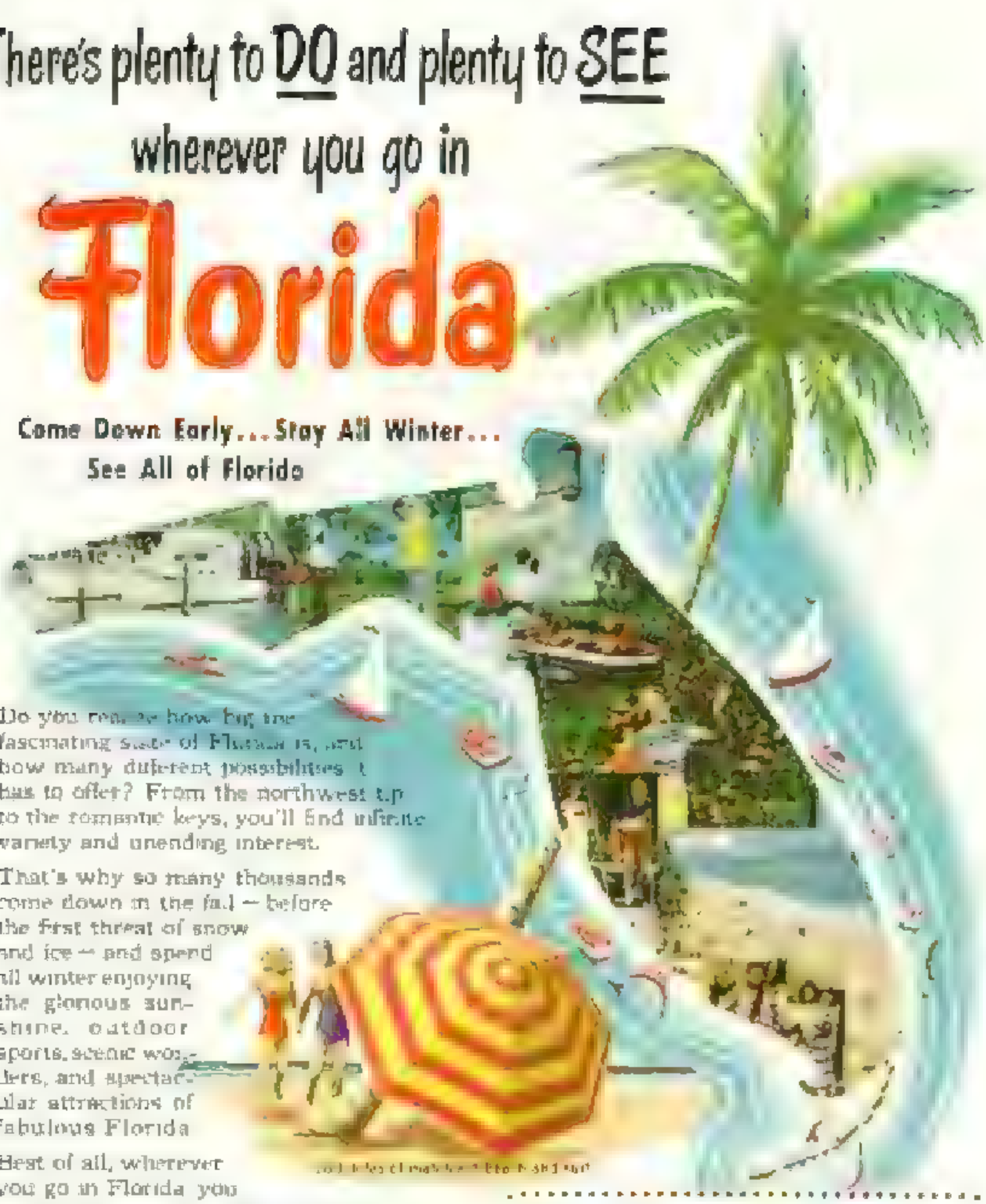

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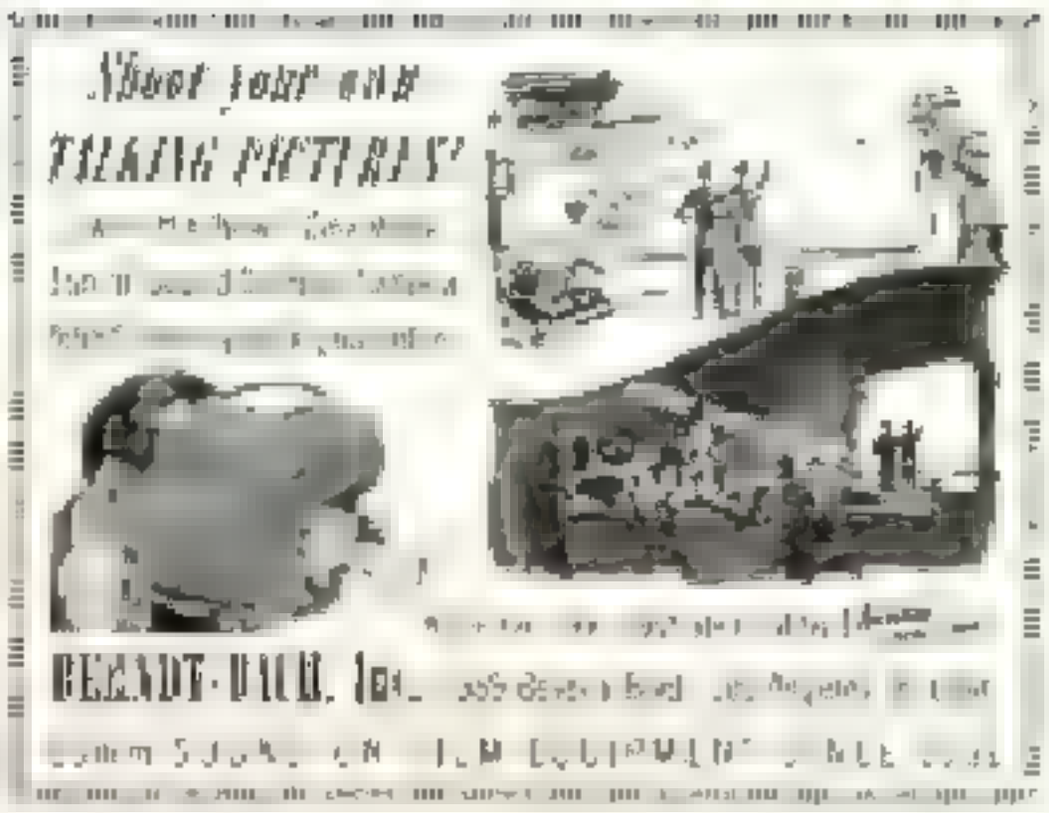

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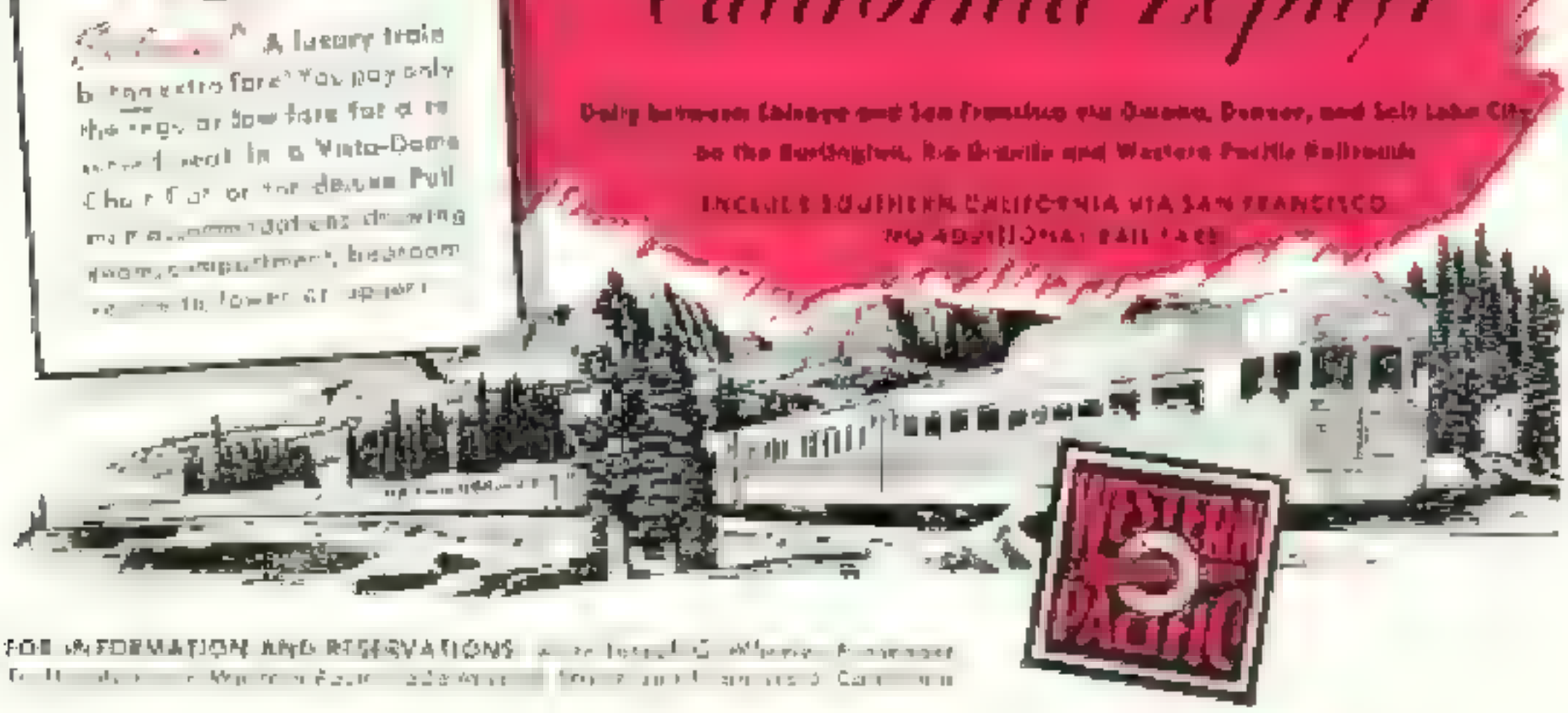

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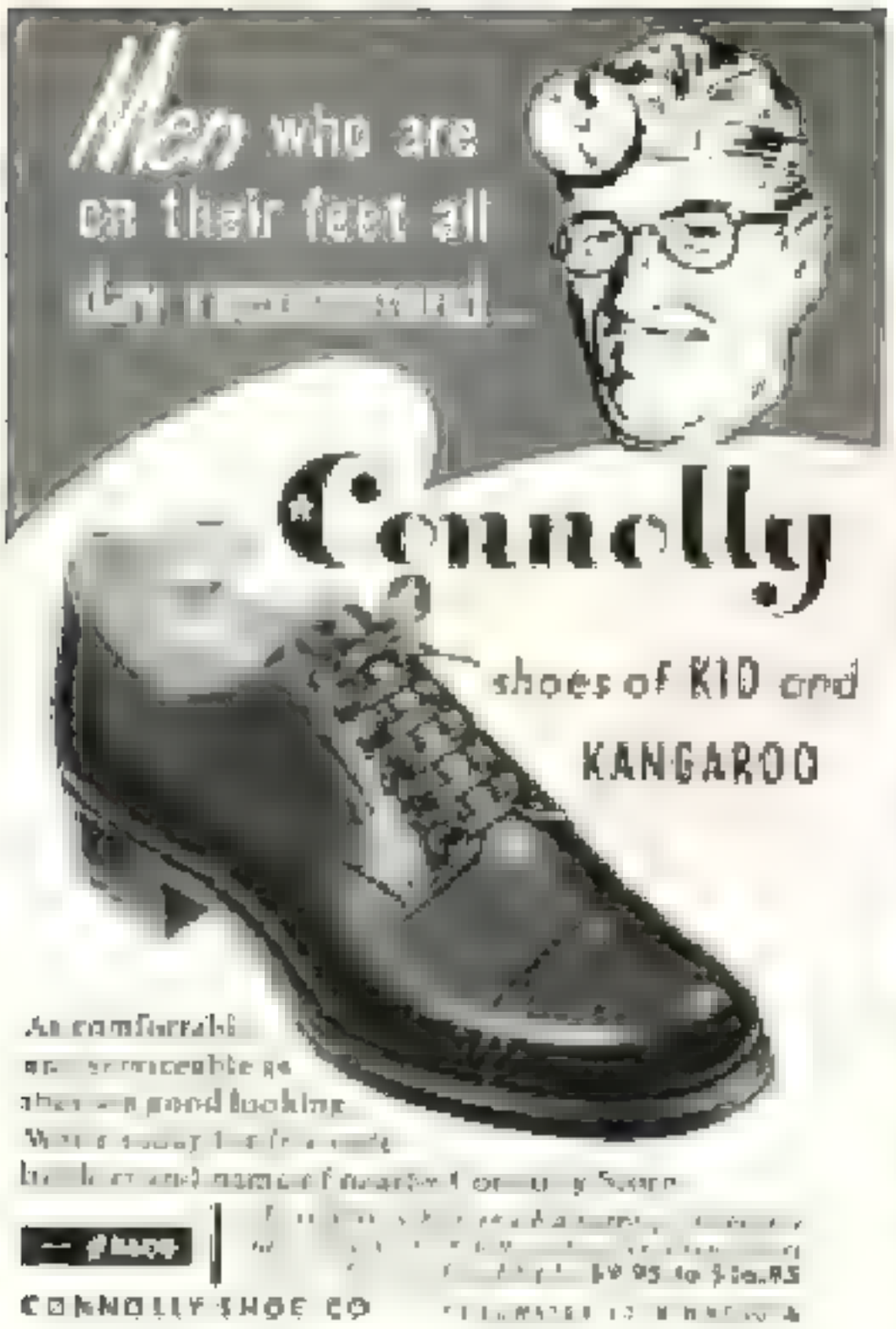

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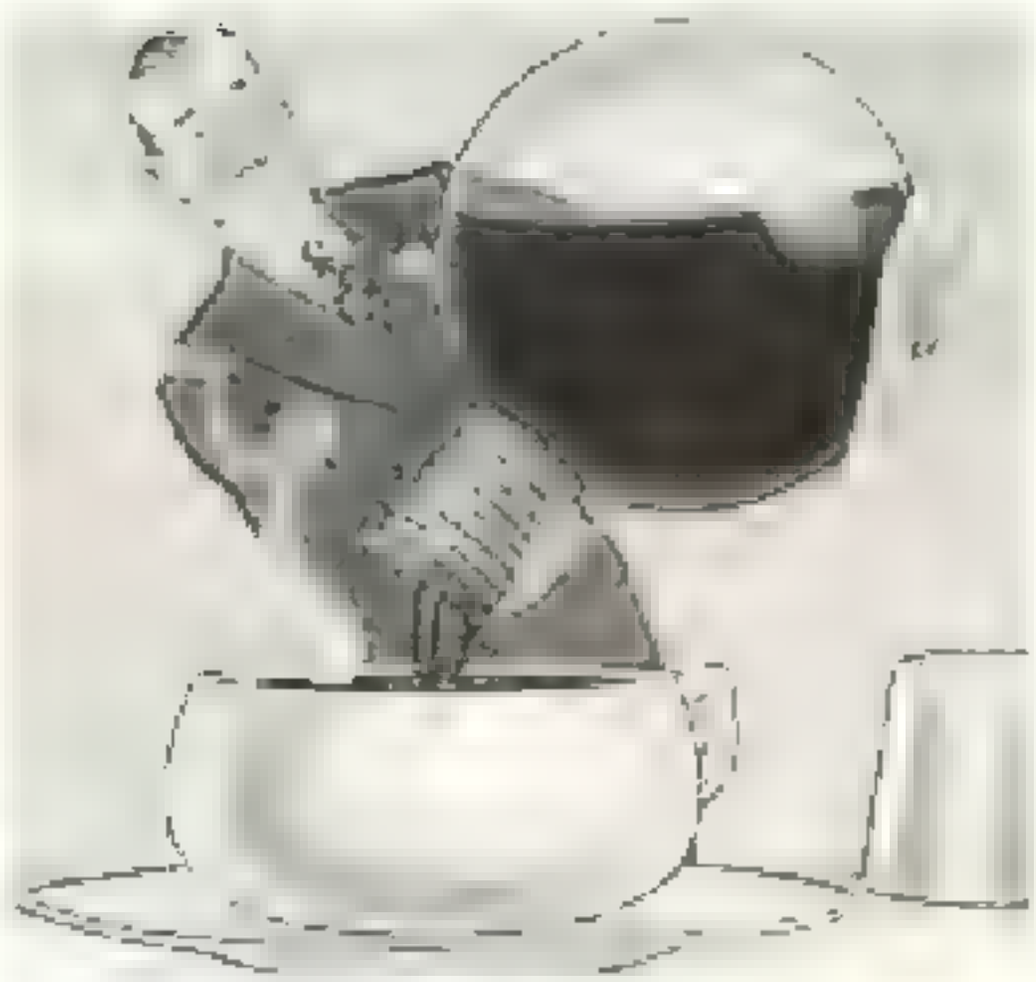

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Today the outlook for most people with arthritis—particularly those affected by the rheumatoid type—is encouraging. This is because medical research has uncovered new facts about the disease, and provided more effective drugs for its treatment.

Such advances are heartening because the arthritic diseases are not only widespread but are second in disabling effect among all diseases in the United States. In fact, the Public Health Service recently reported that more than 10 million people in our country have some form of this disease.

In the sketch above, some basic facts about the two most common forms of chronic arthritis—*rheumatoid arthritis* and *osteoarthritis*—are illustrated. The hand swelling which is characteristic of early rheumatoid arthritis, is shown on the index finger. Since the joint itself is not damaged, prompt treatment may bring complete relief.

The effects of advanced rheumatoid arthritis are shown on the third finger. Here an overgrowth of bone has caused a complete stiffening of the joint. In some cases, however, patients can still use the hand.

The little finger illustrates the enlarged ends of bones and the diminished joint spaces caused by osteoarthritis. It is primarily the middle aged and generally does not cause severe crippling.

Doctors do not consider rheumatoid arthritis simply a disease of the joints. They say that the person who has this condition generally shows signs of disease of the *entire* body. This may be evidenced by loss of weight, fatigue, anemia, dizziness, emotional upset, nutritional deficiencies, and sometimes by other more serious conditions.

While tests [illegible] this way can an exact diagnosis be made and treatment directed to meet the patient's individual needs.

There is no known cure as yet for the majority of arthritics. Medical authorities believe that standard treatment of proved permanent can prevent serious complications in 70 percent of cases, and even completely relieve the painful symptoms in [illegible] cases. The treatment includes rest, good nutrition, medical therapy and other measures.

To help prevent arthritis or lessen its effects, it should occur [illegible] Moreover, it is most important for the patient to realize that relief from any type of arthritis depends largely on close and faithful cooperation with the doctor in all phases of treatment.

Above all, arthritic patients should take an optimistic attitude toward this disease, because worry and mental strain may intensify symptoms. Today it is reassuring to know that *the great majority of arthritics cases can be greatly helped.*

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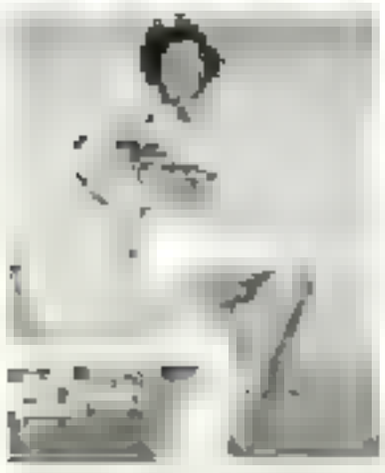

San Diego has [illegible] climate, unlike any other [illegible] a city [illegible] two [illegible] bays, [illegible] sidewalk [illegible] balmy [illegible] warmer [illegible] sweet, less stormy, not nearly as much rainfall.

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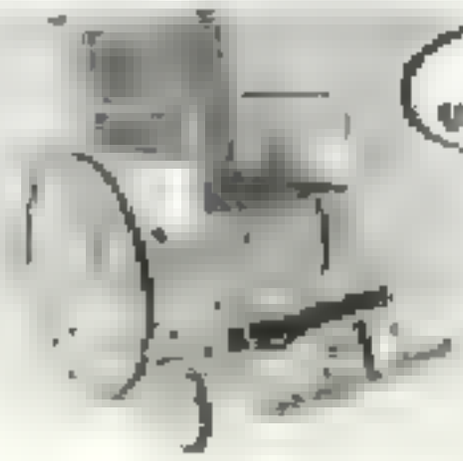

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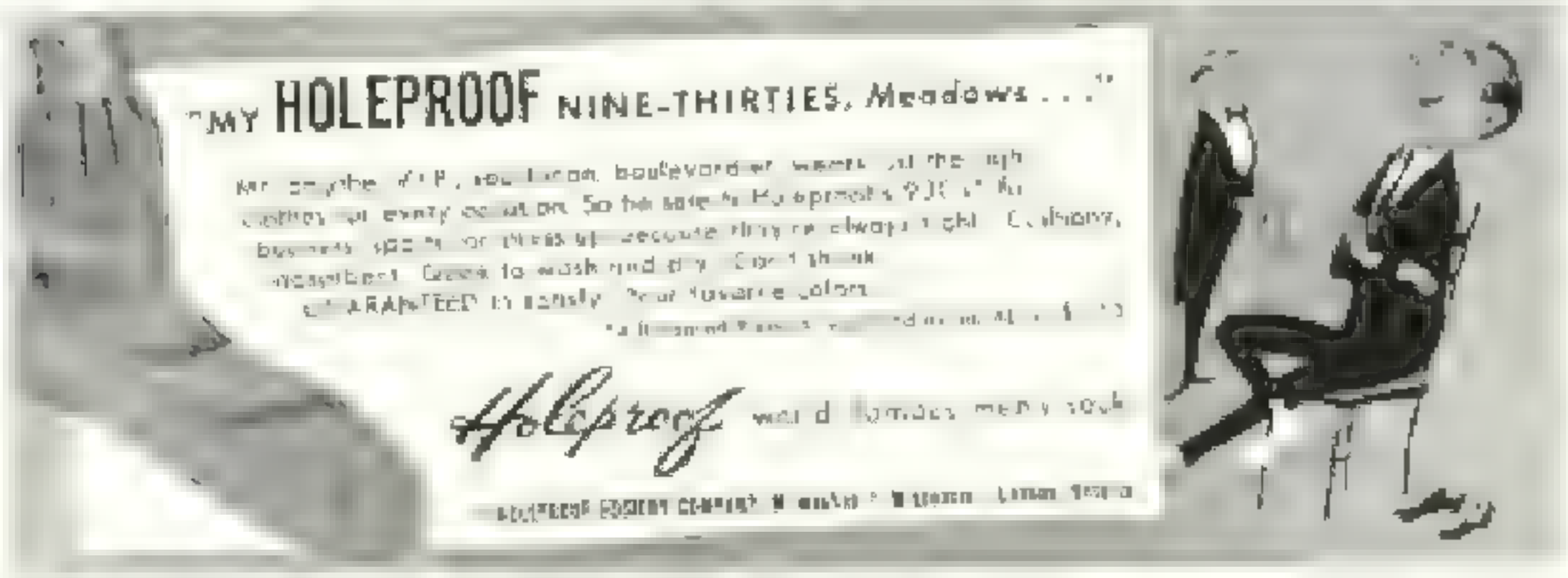

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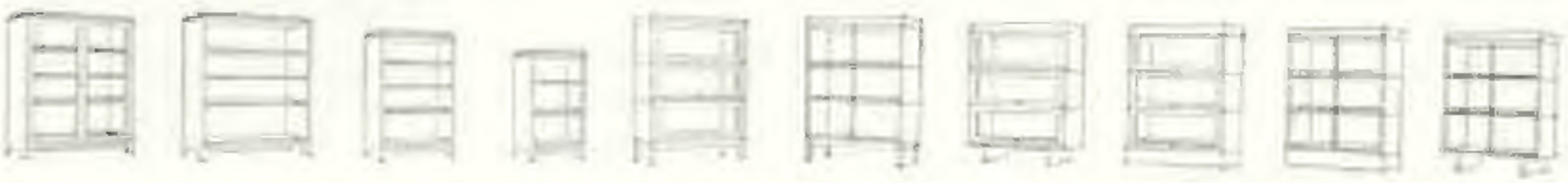

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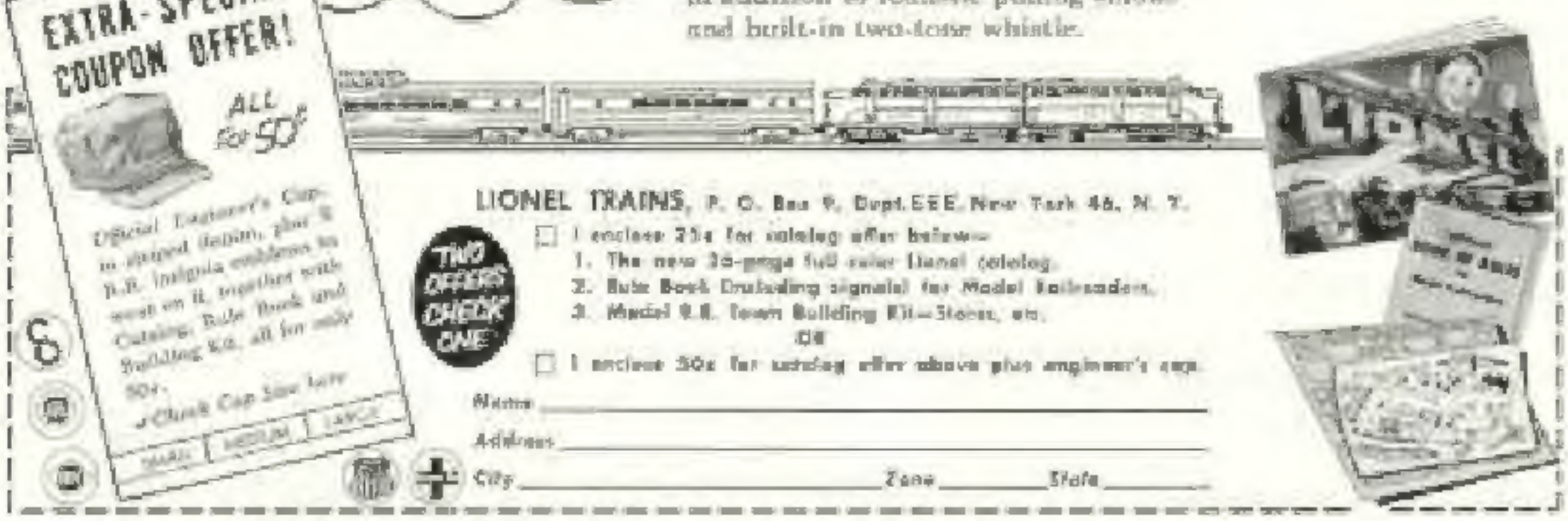

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Immediately people began calling in and rushing in. "Where's the fire?" they asked.

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By warning the town, remaining at her post, and keeping telephone service going, she helped to protect the lives and property of hundreds of people.

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